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EDITORIAL ANNOUNCEMENTS.

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CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

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The Pennsylvania Railroad's tunnel under the Hudson River at Thirty-third street, New York City, is now open through from New Jersey to New York, though it is not yet lined, and will not be ready for trains for a year or two. This tunnel has been pierced in 12 months' less time than was stipulated in the contract, and the work has been done so quietly that people have given it but little thought—the East River tunnel, and its numerous obstacles and dangers, taking everyone's attention. Moreover, the contractors, the O'Rourke Engineering Construction Company, say that there has been no loss of life among the workmen under the Hudson except from causes which would happen in the same way on above-ground work—and there have been but few fatalities from any cause. The alinement and grade lines that were run from the east side are said to have matched those from the west side to within ⅛ in. and ¾ in., respectively. The lines were checked, by using tubes driven through the mud, when the opposite headings were still 125 ft. apart, so that when the shields finally met they were brought practically to a perfect union.

Those who contemplate the substitution of metal railroad ties for wood will do well to study the experience of the German railroads, which has been not only extensive but long. As early as 1868 a report on metal ties was made to the technical convention of the German Railroad Union, and in 1889 no less than 9,902 miles of railroad in Germany had iron or steel ties. In this early period it was hoped to make practically a continuous rail by substituting longitudinal metal sleepers for cross-ties; and at this date 6,181 miles of the total 9,902 had such sleepers. But these lost favor, and by 1900, while the track laid with iron cross-ties had increased to 10,695 miles, the longitudinal sleepers had largely disappeared. In 1903 more than one-fourth of the through tracks in Germany had steel cross-ties, namely, 11,534 miles out against 32,192 on timber ties. The increase since 1889 seems inconsiderable, and there certainly is no such tendency as formerly to abandon wood for iron; but on the other hand the metal ties are not condemned, as is clearly shown by the fact that from 1900 to 1903 the additions to track on steel ties amounted to 1,349 miles, against 3,549 miles on wood. The iron interests in Germany naturally advocate the substitution of steel for wood, and much use is made of the argument from the early impending exhaustion of the forests. Doubtless, in this country at least, we are consuming more timber than we are growing. It should not be forgotten, however, that iron ore and coal are also exhaustible materials, and that while, in course of time, we can grow more timber, we cannot in all time grow more coal and ore.

The tremendous increases in the number of passengers carried by the transportation systems of Greater New York furnish an unfailing source of interest and astonishment, with each recurring quarter. After the subway was opened for traffic in the fall of 1904, both the Manhattan Elevated and the surface lines showed decreases in traffic, although the sum total was greater than ever before. This is shown by the following table:

Paid Fares.

	1905.	1904.
New York City Ry. (surface)	379,721,637	380,749,591
Elevated roads	249,965,166	292,646,674
Subway	116,209,313	16,241,869
Total	745,896,116	689,638,134

The New York Railroad Commissioners have now published returns for April, May and June, 1906, and these show that the surface lines have passed all their previous records, in spite of the subway competition, and that the elevated lines are nearly in their former position, and will presumably pass their 1904 high record in another season. The figures of this traffic, printed below, possess the highest interest to the student of the complex transportation problem in New York:

Paid Fares—Three months Ended June 30.

	1906.	1905.	1904.
Surface lines	101,971,383	99,059,455	100,047,585
Elevated lines	69,164,266	64,551,703	75,751,031
Subway	37,161,607	26,942,295	.....
Total	208,297,256	190,553,453	175,798,616

In two years, that is to say, the *increase* in the paid fares during a given three months' period amounts to nearly 32½ millions. If we assume, roughly, that every traveler paid two fares on each of the 91 days comprising the period considered, it appears that 178,564 *more* persons were using the New York transportation lines in the spring of 1906 than in the spring of 1904, and that the total number of travelers (not trips) per day was something like 965,926 in 1904 and 1,144,490 in 1906. In other words, a throng of travelers equal in number to the population of Boston plus that of Cleveland rode twice daily over the lines in the spring of 1904, and were augmented in 1906 by the entire population of Rochester! Supposing the same rate of increase to keep up for the next fourteen years (and there are no indications that it will not keep up, and increase the rate besides) the transportation lines of 1920 will have to face a movement of 3,759,225 persons taking 7,518,450 rides daily.

What are all these people going to ride on? Taking the aggregate of the heaviest days in 1904, 1905 and the first half of 1906, it appears that about 3½ million rides can be accounted for without materially straining existing facilities. There remain four millions to be accounted for, and it would take eight additional subways like the existing one to carry them, at the present basis of travel.

GROSS EARNINGS AND DIVIDENDS.

The commercial prosperity of the country has been so great this year, and the railroads, with a mild winter to keep their expense account down and tremendous traffic to bring their earnings up, have been making a remarkable showing for so long that the news of it has become commonplace. But with the close of the summer months, the annual statements of most of the principal companies are now available, and they furnish a record which demands fresh comment, even after all that has been said and written on the subject. The accompanying table shows the gross earnings, in two cases partially estimated, of 21 companies, for the year ending June 30, 1906, in comparison with the previous 12 months. In several instances, it must be observed, this is not the fiscal year of the road concerned, but the comparison will serve equally well.

Company.	Gross earnings 1906.	1905.
Atchison, Topeka & Santa Fe	$78,044,342	$68,375,834
Baltimore & Ohio	77,392,056	67,689,998
Canadian Pacific	61,669,758	50,481,882
Chesapeake & Ohio	24,602,986	20,724,368
Chicago & North-Western	63,481,575	55,745,273
Chicago, Burlington & Quincy	73,500,000*	65,973,046
Chicago, Milwaukee & St. Paul	55,149,000*	49,884,000
Chicago, Rock Island & Pacific	51,237,854	44,051,509
Cleveland, Cincinnati, Chicago & St. Louis	23,649,295	22,372,312
Great Northern	49,505,383	41,608,430
Illinois Central	51,636,405	49,508,650
Lake Shore & Michigan Southern	41,040,962	36,189,749
New York Central	89,785,260	81,289,967
Norfolk & Western	28,487,763	24,089,257
Northern Pacific	62,140,410	57,729,362
Pennsylvania Lines East	142,317,467	123,424,367
Pittsburg, C., C. & St. Louis	28,361,771	25,029,370
Southern Railway	53,641,438	48,145,108
Southern Pacific	105,619,114	95,515,158
St. Louis & San Francisco	38,626,399	35,319,478
Union Pacific	67,281,543	59,324,949
Total	$1,267,170,781	$1,122,472,067

Increase, $144,698,714, equal to 12.9 per cent.

*Approximate.

This increase takes a more graphic aspect when we realize that it is larger than the 12-months earnings of the Pennsylvania Railroad for the current year; larger also than the entire earnings of the railroads of the United Kingdom from merchandise traffic in the year 1905. This 1905 year was a bumper one in England, so far as railroad results were concerned, and the total United Kingdom system earned $551,848,140; an increase of nearly 1½ per cent., which received much comment. We have a basis of comparison, therefore, in showing that in one bumper year, 1906, the increase in earnings on a group of our representative roads was somewhat more than ten times as great as the increase in the earnings of an equally representative group of British roads in their bumper year, 1905. Moreover, 1905 was a good year with us also, while 1904 in Great Britain was not an especially good year, so that we had, so to speak, a more difficult take-off for our leap in earnings than Great Britain had.

What is going to be done with this great piling up of new values? Is the money going to be turned back into the property again, as has been so consistently the practice since the lean years of a decade ago, or are minority shareholders all over the country going to come into their own with Union Pacific-like suddenness, when directors meet this fall? And which of these things should be done? There has probably never been a time in American railroad history when these questions were quite so prominently agitated as they are now—or a time when there was as much honest doubt in the minds of directors regarding the course which they should take. The American theory of the dividend is directly involved, and the attention of the public is so sharply fixed on the rights of minority shareholders that many companies will doubtless find it expedient to give this theory, now rather intangible, the definite form of a doctrine.

Let us assume, then, the unwritten rule of American railroad dividends, as applied by conservative companies in the present generation—that the property must be so maintained out of earnings that at the end of the year it will be in as good shape to meet conditions to come as it was at the beginning of the year, not only as regards the average age of its ties and the tonnage capacity of its locomotives, but also as regards any new circumstances of traffic or of competition which may have arisen. After that, floating debt, sinking funds, car trusts and other miscellaneous charges must be looked after, and these also should be left in fully as sound condition as when they were last taken up, 12 months previous. Then comes the dividend, to be declared at a rate that can be maintained, so far as ordinary foresight can determine, and will presumably not be subject to immediate unfavorable fluctuations, and after the dividend has been paid there should remain a good round surplus to add to the profit and loss balance carried forward as a provision for special needs or hard years.

This is the theory, but the practice in these years of great prosperity has been to put far more value back into the road than wear-and-tear and traffic conditions have taken out of it. The present Lake Shore & Michigan Southern is to all intents and purposes a railroad built new from its surplus earnings; the average charge for locomotive repairs and replacements on the Southern Pacific is nearly $4,000 per locomotive per year. Atop of such excessive prudence and ultra-conservatism come the great earnings of 1906, with the certainty that surpluses will be not merely greater, but much greater, than ever before. An attempt has been made, in the table which follows, to estimate how much each of the roads listed is earning on its common stock. The results are not guaranteed, and might conceivably vary considerably according to the temperament of the estimator. Moreover, full returns are not at hand, in some cases. But the idea has been to apply the dividend theory as expressed above, omitting only the item of surplus to be carried forward. The results are as follows:

	Common stock Earns, per cent.	Pays, per cent.
Atchison, Topeka & Santa Fe	11	4
Baltimore & Ohio	12	6
Canadian Pacific	14	6
Chesapeake & Ohio	7	1
Chicago, Milwaukee & St. Paul	11†	7
Chicago & North-Western	20	7
Chicago, Burlington & Quincy	19	7
Chicago, Rock Island & Pacific	10	6¼
Great Northern	17	7
Illinois Central	11	7
Lake Shore & Michigan Southern	25	8
New York Central	6	5
Norfolk & Western	12	3
Northern Pacific	14	7
Pennsylvania Lines East	12	6
Pittsburg, C., C. & St. Louis	7	3
Southern Pacific	10	5
Southern Railway	1½	0
St. Louis & San Francisco	1	0
Union Pacific	18	10

†Both classes.

It is impossible to take up in detail the study of each of these cases; the method employed has been to estimate maintenance needs liberally, not by any general standards, but by the local standards in the section of the country where each of the roads operates, with due allowance for special conditions, such as bad water, preponderance of light equipment, etc. It is at least safe to say that English practice would find the sums as listed—and probably considerably greater sums—available for dividends.

Some of the items on the list require comment, however. It is evident that the sum available for dividends on the New York Central depends directly upon the dividends paid by other Vanderbilt properties in the stock of which the New York Central is a large investor. The long policy of over appropriation for maintenance and replacements on all the Vanderbilt lines would enable the Lake Shore or the Michigan Central to increase their dividend rate many points, thereby adding to the available revenue of the New York Central just as the Southern Pacific was made to add to the revenue of the Union Pacific. Mr. Harriman emphasized this state of affairs in dividing the Union Pacific net income into two parts—income from operation and income from investments. In the case of the Canadian Pacific, the 14 per cent. listed does not attempt to show the rights of the common stock ("equities," in stock exchange parlance) in the tremendous land holdings in the northwest, sales from these holdings being credited direct to profit and loss, in a separate account. Nobody knows what the ultimate sale value will be of the 13,000,000 acres of land which the company owns, and many years must pass before it is disposed of, unless a land company is formed to take over the entire holdings. In the case of the Southern, of the St. Louis & San Francisco and certain other lines on the list, notably the Atchison and the Great Northern, a tremendous amount remains needed to fully develop the properties. Prosperity for the Southern roads is a new thing, and the long struggle for existence of most of the roads now forming the Southern Railway has left them in poor condition, with large requirements that should properly be met out of the earnings of the present good years. In the northwest, it has not been lack of prosperity but rapidity of development which has accounted for the general condition of under-maintenance. The Hill lines are

showing in miniature the physical history of American railroads, year by year—rough track, hastily built into undeveloped country, and perfected gradually, to meet the needs of rapidly increasing traffic.

But with all these qualifying facts in mind, it remains evident that the majority of the roads listed herewith, together with many others not on the list could, this year, pay their dividends on the common stock twice over without incurring a deficit, and that some of them could do considerably better than that. And it is becoming every year more apparent that traffic growth which has its basis in the general development of manufacturing interests throughout the country is very different from one-crop or one-commodity traffic growth not otherwise supported. To quote a recent statement by an officer of a railroad operating in the central and eastern states, "Nobody can realize how many new industries have started up all along the lines, each adding its little extra demand on us, until the aggregate total is staggering." It is evident that this is going to check the violent fluctuations which have always characterized American railroad traffic. The change must be gradual, with plenty of lean years ahead, but the lines built to haul grain, or lumber and forest products are year by year getting higher percentages of the manufacturing business that is not killed by drought or exhausted when the forests are cut off.

The coal roads, especially the bituminous roads, may properly be grouped more nearly in the "one crop" classification than any other special carriers, under present conditions. The great current earnings of the Baltimore & Ohio would have been materially reduced under the market conditions and existing rates of a few years ago, and the sources of bituminous output are so scattered and the underlying tonnage so tremendous that no community of interest exists similar to that among the anthracite roads. But the coal will always be there—always, at least, during any period of time with which we need concern ourselves—and the manufacturing industries will need more and more of it every year, to say nothing of the great and constantly increasing fleet of steamships on the ocean and the lakes. The two new Cunard steamships "Mauritania" and "Lusitania," now building, are scheduled to burn 1,200 tons per day, each, and will take on board at New York for every trip enough coal to load four trains made up of thirty 50-ton cars.

Suppose that we roughly divide the demands upon net income, after satisfying fixed charges and taxes and taking proper care of the floating debt, into three heads—maintenance, strategy and surplus. It is apparent that the extraordinary maintenance needs which have followed the bad years of the 1897 period will not long continue, except in certain special cases as mentioned. The application of earnings and of credit to strategic purposes, as in the case of the Reading holdings of the Lake Shore, is a matter of much less certain limit, and must always vary in accordance with the policy of the management, tempered by the strength of minority stockholders' organizations. The "surplus" item seems already well taken care of in most instances, and surplus is cumulative. Have we not arrived at the period, therefore, when the stronger companies will inevitably find it expedient to increase dividends? Wall Street evidently thinks so, as witness Lackawanna, a 10 per cent. stock selling around 550; Great Northern, paying 7 per cent. and selling above 300; Atchison, with its 4 per cent. common stock selling nine points above its 4 per cent. preferred. If it is true that British shareholders have been taken care of at the expense of the railroad, it is also true, especially in recent years, that American railroads have been developed at the expense of the shareholder. The best course lies somewhere between the two, and there are present day indications that we are tending towards it.

THE PUBLIC ATTITUDE TOWARD RAILROADS.

The philosopher who watches the changes of affairs and of men must often, vaguely or definitely, have reflected how in these days the old proverb about familiarity breeding contempt must be modified. Especially is this true when we try to fit the proverb to great civic or physical questions in national life. For the word "contempt" in the old saw must, in such cases, be substituted nouns like criticism, exaction, regulation, system—any one of a dozen nouns more or less abstract. The thing of original terror, wonder, curiosity and profound interest becomes by familiarity, and as it gets to be an institution, a thing to be watched, studied, criticized. It passes not merely from a formative to a scientific stage but also to a status controversial and censorious. And in that process, often long and complex, there is the old danger of extreme and radical policies with another proverb as to the wisdom of the midway course—in the Latin *in medio tutissimus ibis*—coming to our rescue.

Nothing has more strikingly illustrated the point than the history of the railroad, and particularly of the American railroad. At its outset, three-quarters of a century ago, the railroad, of course, encountered opposition, but it was almost exclusively the opposition of interests—turnpike companies, stage owners and the like. Communities and men, in the bigger sense, were in favor of the railroad enthusiastically, and that support long continued. It even reached, for a period not brief, something of reverence vague and blind. Men do not have to be white haired to recall the intensity of public and personal interest in the old-fashioned railroad. The conductor was not in uniform but eke in his plain and dingy vestment was a little god on wheels whose pleasant word was like the off-hand dictum of a prime minister. The engineer was not only a god on wheels but a god behind the machine. The car might be narrow, its seats rough and its "express" speed fifteen miles an hour, but, in popular and individual vision, it eclipsed the majesty and pace of the modern Pullman. The small boy, who now views with placid interest the coming of the huge locomotive pulling its dozen passenger coaches, in those days put his fingers in his ears and ran howling behind the station as the wood-burning smoke stack drew up. Broader forces for several early decades contributed to deepen sympathy as well as reverence for the railroad. Except the telegraph no great invention came in to dim the railroad novelty in contrast with the later times of the telephone and of electricity as a motive power; and a great country with a vast frontier constantly pushing westward to the popular cry for more railroads promoted the spirit of concession to the railroad corporation.

We have changed all that. From an object of isolated grandeur and awe the railroad has become familiar not to say commonplace. New triumphs of electricity have impaired what we may call the railroad's dramatic power; and it has entered more deeply into relations of public convenience and necessity. As a secondary but most important sequel we find it the object of systematic attack from many directions—federal, state, municipal, and partisan as well as individual. The major causes of this wide swing of the pendulum of public opinion we do not now recount beyond those named, and the statement that there have been abuses on both sides. But a situation may be outlined that suggests the argument for moderation.

In the first place may be noted as a fact that the existing period of railroad prosperity has its drawbacks—one and the most serious of which is its tendency to lead to popular misjudgment—a misjudgment in which it is painful to see some thinking minds share. We see here again that old and so often misleading argument of coincidence—the synchronism which leads people to infer wrongly a relation of cause and effect. This present time of railroad restriction and regulation happens also to be a time of exceptional railroad prosperity, therefore the policy of restriction may be pushed far. Such is the reasoning that reminds one of Bastiat's ironic simile that because the higher culture of French sheep was indicated by smaller heads, sheep culture would reach its ideal when French sheep had no heads at all. How many persons, not a few of them intelligent and educated, realize that the large face profits of the first part of the present epoch of "prosperity" were used by the railroad companies to make good belated repairs or improvements, some of them on a vast scale and involving expenditures—like those of the Pennsylvania company in New York city—as to which untold years must elapse before even a moderate return on cost. In some cases with those improvements completed there have come dividends new or increased. But have they yet reached a size or an assurance that sanctions the arguments that, so long as they continue, the policy of sharp restriction should be indefinitely pushed and pushed often, in the shape of general legislation or policy that affects the struggling railroad, the unimproved railroad and the prosperous railroad all alike? As regards the public attitude toward railroad prosperity there is here a clear call for discrimination and coolness in opinion as well as the consequential policy.

This brings us to the often mooted question of the nature of that prosperity itself and its warning to both sides—the railroad finances on the one hand and the "anti-railroad" public on the other, east and west, but particularly at the west. Many signs seem to suggest that the prosperity of the railroads is pretty enduring or that, at least, a period of industrial depression will find them ready for successful economies. But the signs are far from conclusive. The historical rule as to the periodical recurrence of financial crises following high tides of prosperity has, during the last decade been falsified owing chiefly to the quick combinations of capital to resist

them. As a result of those combinations the financial tides have risen and receded slowly without a destructive break, and in the face of disclosures and influences which ordinarily would have spelled panic. But has that experience been long enough and deep enough to assure the future and confuse those prophets who have been telling us of the coming time, soon or late, when the depth of the trough of the sea will correspond with the crest of the present high wave of prosperity? It is, of course, a speculative question. But it is grave enough to call halt on those who cry railroad prosperity as justification of their attack. And, at the other extreme, far more sharp is its rebuke of those railroad financiers and combinations who use a railroad prosperity which may, after all, be but transitory, to coin their own profits in the street with equal offense to public sentiment and injustice to the *bona fide* stockholder. With so recent an example as the Harriman dividends do we need to go farther in stating a force more provocative than original grangerism or socialism in rousing unduly public sentiment against the railroads and stimulating the call for public ownership?

In viewing the general situation one is impressed also by the variety of the lines of attack. In New Hampshire it has been specifically railroad influence in the state legislature and the too free use of the railroad pass; in Massachusetts executive resistance to steam railroad acquisition of the street railway lines; in Ohio and elsewhere reduction of general passenger rates to two cents a mile; and in many states movements of varying magnitude in favor of state or federal ownership. Not all of these attacks bear the ear marks of demagogism, but many of them do and, almost throughout, the utterances and arguments, while aimed sometimes at a real evil, are crude, unstudied, the expression of an impulse rather than of basic conviction. Collectively, no doubt, these various assaults reinforce each other in creating immature public sentiment on the railroad question. But in spite of that fact there is considerable safety in the distributive character of these diversified attacks. They at least localize the questions at issue and let them be examined at short range. If, in the ultimate result, the bad failed and the good prevailed one could view these state outbreaks with complacency; but, in fact, usually at last both good and bad go down together as some new and more dramatic issue swerves the commonwealth. Yet, after all, some residuum of good is apt to remain as a basis of principle, solidified by new experience, for working out a solution along conservative lines. On that conservatism, apt to be slow but also apt to be sure, checking on the one hand the incursions of the demagogue, and, on the other, the selfish tactics of predatory wealth, must our hopes of a sane public attitude toward the railroads rest.

On the New York, New Haven & Hartford recently, three prominent citizens—a former governor, a president of the State Business Men's Association and a lawyer—refused to pay their fare on a crowded train from Bridgeport to New Haven because they couldn't get seats, and the company has issued a public statement reminding the dignified (?) violators of the law that they ought to have been arrested. The statement says:

"A common carrier of passengers is bound to furnish reasonable seating accommodations for the average number of passengers carried by it. It is not bound to buy enough passenger cars to furnish seating capacity for a few days in the year when travel is at its height if such cars would remain unused at other times of the year. A passenger has a right to a seat in a train, but he has not a right to a seat in any particular train, and if he boards a train and finds the seats are exhausted, he has no right to insist upon a seat before paying his fare. It is his option to travel on that train without a seat, or to get off and take the next train upon which he can get a seat. If he insists upon remaining upon a train where there is no seat, he must pay his fare, or be subjected to the statutory penalties for the evasion of fares. This doctrine is supported by Baldwin's American railroad law and by other decisions."

We commend Mr. Mellen's action to other roads. To the conductor the question of carrying out his instructions and compelling such passengers to pay their fares is always an embarrassing one—as well it may be, for the legal controversy *appears* to be so much like a civil case and so little like a criminal one that he has no sympathy from the public. The railroad can, indeed, well afford in most cases to proceed as in a civil case. To fully record the facts, however, and then give them to the public with names, as was done in this case, inflicts on the offenders an appropriate punishment, while the only satisfaction that they have got is that to be found in forcing a conductor to disobey his instructions, and in saving a little money; in this case the magnificent sum of 75 cents—25 cents apiece.

But a railroad that desires to live on pleasant terms with the people who travel in its cars must be very careful not to test this law too often. An aggrieved passenger who must come into court and prove that a railroad has not supplied itself with an adequate supply of passenger cars for its average business is at a great disadvantage, and judges, as well as juries, will for that reason sympathize with him. Therefore, to maintain a fair standing with the public a railroad must furnish more cars than a precise interpretation of the common law would require; and a *good many* more. To take an illustration familiar to all, many new passenger cars which were ordered soon after the beginning of the present period of activity in business were delivered from six to eighteen months after they were needed. We are not blaming any manager for not ordering new cars before he could see where he was to get the money with which to pay for them; but the fact remains that the public will, if it can, hold a carrier strictly responsible for providing vehicles well in advance of the need for them. Where the public cannot get what it believes to be its rights, it takes, in place thereof, anything belonging to the railroad that it can get hold of. Again, a heavy responsibility rests on the trainmaster or other officer who assigns the cars to different districts and trains. The task of a coal-car distributor in West Virginia would be easy, compared with this one, except for the fact that quite serious failures and errors in the passenger-car field are necessarily unpunishable because no one can crystallize the grievances of the ill-used passengers. The passenger-car distributor not only should be skilful and alert, keeping his records accurately and watching the needs of different stations every day; he should also have a sensitive regard for his duty to the public, for the reason, just mentioned, that the public is powerless to get even with him for a failure. Perhaps the hardest detail to deal with is the case of a heavy local train which is used by a very regular patronage. The numbers being regular, day after day, and filling, say, six or seven cars with not over 25 seats to spare, it seems a waste to furnish another car for the sake of providing 50 seats, when the 50 passengers will not appear more than once a month. There must be many trains, we should think, where the carrying of two or three dozen light camp chairs in the baggage car would be the means of allaying much friction. Of course, it would not do to relax the effort to provide a reasonable supply of regular seats; for that would lead to charges of stinginess. In a real emergency, an emergency known to be such, there would be enough passengers to accept camp chairs cheerfully. And this suggests that frankness with the public is a very good thing. Conductors ought to be taught to manifest it more freely. The ideal conductor is on pleasant speaking terms with a sufficient number of passengers, of different temperaments, to make it easy for him to be affable with any reasonable passenger at any time. With such a conductor, passengers who are asked to put up with camp chairs will not be so likely to "sass" back. To some conductors the suggestion that a man in such a position can be constantly affable will be resented. Their stern and unpleasant duties make affability seem incongruous. They will laugh at us, and almost laugh at their own superintendent if he listens to us. But do you not, after all, Mr. Conductor, entertain in secret, a warm admiration for those conductors to whom affability is natural?

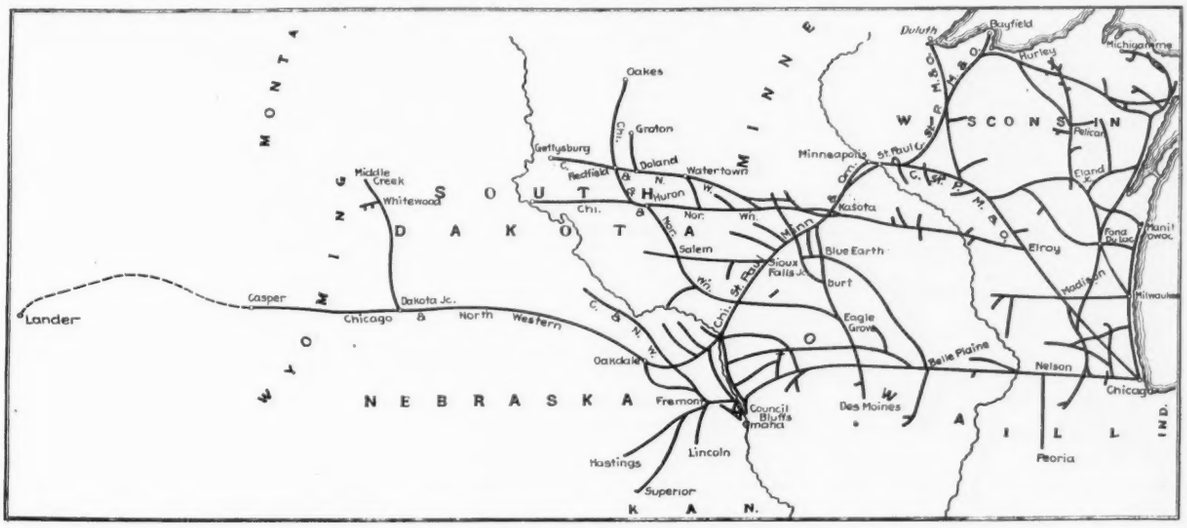
Chicago & North-Western.

The pioneer granger line—the first railroad in Chicago—presents a report interesting not only because of its evidences of great prosperity, but also because it points to a certain change in characteristics, shown this year rather more clearly than before. Earnings, both gross and net, were far in excess of previous records, and the usual economy of operation was manifested. The road earned, gross, $63,481,578, as against $55,745,275 in 1905, and net, after taxes, $21,265,302, as against $17,095,964. The year's dividends, 8 per cent. on the preferred stock and 7 per cent. on the common, absorbed less than half of the net income, and out of the balance the striking sum of $6,000,000—nearly one-tenth of the gross earnings—was appropriated for construction and betterments. During the five years just ended the company has taken in the aggregate $24,310,473 for these purposes; just about the same amount that has been paid out in dividends during that period. As we point out in another column, the company, had it so chosen, could this year have paid 10 per cent. dividends on its preferred stock and 20 per cent. on its common.

What the future of the road is to be; whether it is to rely mainly upon local or upon through traffic, is one of the interesting questions which the current report suggests. During the latter '80s the average freight haul of the North-Western decreased, following its policy of branch line extension. This haul was 178 miles in 1887, 162 miles in 1888, and 152 miles in 1889. The Vanderbilt-North-Western-Union Pacific community of interest has since then given it a larger haul; 238 miles in 1905 and 263 miles this year, as against 175 miles in 1905 on a road which may at present be taken as typical of a local carrier in the northwest, the Chicago, Milwaukee & St. Paul. But the St. Paul has already announced its intention of creating its own route to the coast, and at the meeting of North-Western directors, Oct. 18, action will be taken on the

proposal that that company authorize an increase in the limit of capital stock to $200,000,000, by increasing the authorized common stock to $177,604,880. At present the preferred stock stands at $22,395,120 and the common at $77,601,045.

No announcement has been made of the purposes for which this stock is desired. It is undoubtedly true that it will in any case be to the company's advantage to have its capital limit further removed, as was done by its neighbor, the St. Paul, by the Union Pacific, the Southern Pacific, and the New York Central. But the direct use for new capital in the case of the New York Central and the Harriman roads is very plain, and the supposition that the North-Western desires to emulate the St. Paul in reaching westward is not a remote one, in view of the fact that its other immediate needs seem well provided for. What the coast connection is ultimately going to mean in the shape of increased earnings for the roads concerned is still problematical, for that part of the country is very young, but the efforts to reach the Pacific and the Canadian northwest constitute a striking epoch in American railroad development of the present day. With its own line to the coast, the North-Western would be in the unique position of receiving three types of business usually remote from each other: the long, through haul; the originating grain business of the northwestern states, and a heavy commutation passenger traffic out of Chicago.



Chicago & North-Western.

All the road's passenger traffic, through, emigrant and commutation, is showing good increases year by year, but it is especially interesting to note that commuters constituted over half of the total number of passengers carried in 1906, while commutation earnings amounted to more than 13 per cent. of the total earnings from passengers. Passenger rates are still pretty high; in spite of the proportion of commuters, excursion and emigrant fares, they averaged 2.05 cents per mile, with an average distance traveled of 30½ miles.

It is expected that the Milwaukee & State Line Railway, giving the company a continuous four-track system between Chicago and Milwaukee, and providing for further increase in short haul passenger traffic, will be opened in October. It must be only a question of time, and no long time at that, before all such short and busy strips in the vicinity of great cities are worked by electricity, and it would not have been surprising if the North-Western had announced electrical plans in connection with the four-tracking, but Chicago does not yet feel the need of this to anything like the same extent that New York does. Other new construction during the year includes the completion of a new 102-mile line in Wyoming and the practical completion of 45 miles more of the same; also nearly 165 miles in Wisconsin. A 26-mile extension is being built in South Dakota, and 170 miles more are to be built in the same state through the medium of proprietary companies. It is not surprising, in view of this branch line development, to see that traffic density scarcely increases at all; that freight density was actually less in 1905 than in 1901, although in 1906 it is slightly greater. It may be said that the characteristic development of the company during the last decade—and indeed since the outset—has been expansion through eight thin branch lines, that have justified their construction with surprising rapidity, although the proprietary companies were for a good many years a burden.

The maintenance charges of the North-Western, in spite of this branch line mileage, are a never-failing source of surprise. We said in the *Railroad Gazette*, 20 years ago, that the company was not spending enough on track and buildings, yet the sums charged to the maintenance of way and structures account, per mile worked, have not really increased materially in that period, especially when the vast physical charges are considered. In 1906 maintenance of roadway and track cost only $750 a mile, while the total maintenance charge for bridges, buildings, track, interlocking, etc., foots up at the rate of about $1,000. The Atchison, the Southern Railway, and the North-Western used to stand about on a par for the slimness of their maintenance charges, but the Atchison in recent years has pulled ahead, while the Southern, in spite of the character of the country and traffic which its great mileage of branch lines serve, is some $25 per mile ahead of the North-Western at the present day. In maintenance of equipment, replacements were charged very liberally this year, to the extent of some $3,750,000, but actual repairs were kept down to a surprisingly low figure—$1,600 per locomotive, $500 per passenger car, and $40 per freight car. Several facts must be kept in mind in connection with this, however; the North-Western operates in a territory where water is exceedingly good, and it has a large amount of very light equipment in service. The very fact of the heavy freight car replacements this year will probably increase this account in 1907, even though the equipment is new.

The principal operating statistics follow:

	1906.	1905.
Average mileage	7,429	7,408
Passenger earnings	$14,441,415	$13,339,714
Freight earnings	45,802,853	32,292,830
Gross earnings	63,481,578	55,745,275
Maint. of way and structure	6,864,898	7,466,944
Maint. of equipment	9,032,135	6,419,180
Conducting transportation	22,786,687	21,460,447
Operating expenses and taxes	42,216,276	38,649,312
Net earnings	21,265,302	17,095,964
Net income	14,800,553	10,417,822

CONTRIBUTIONS

The First Railroad Owned and Operated by a Government.

Yeadon, Pa., Aug. 31, 1906.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I value highly your recent letter expressing appreciation of my article on the old railroads of the state of Pennsylvania, which you published in the *Railroad Gazette*, August 24, and I am much pleased with the care you evidently took in its preparation for publication. The only criticism I would make is that under the line drawing of "William Penn" also appears "P. R. R. No. 1." This probably arose from a misunderstanding of the lettering on my tracing, which is arranged thus:

WILLIAM PENN.
HENRY CLAY.
P. R. R.—No. 1.

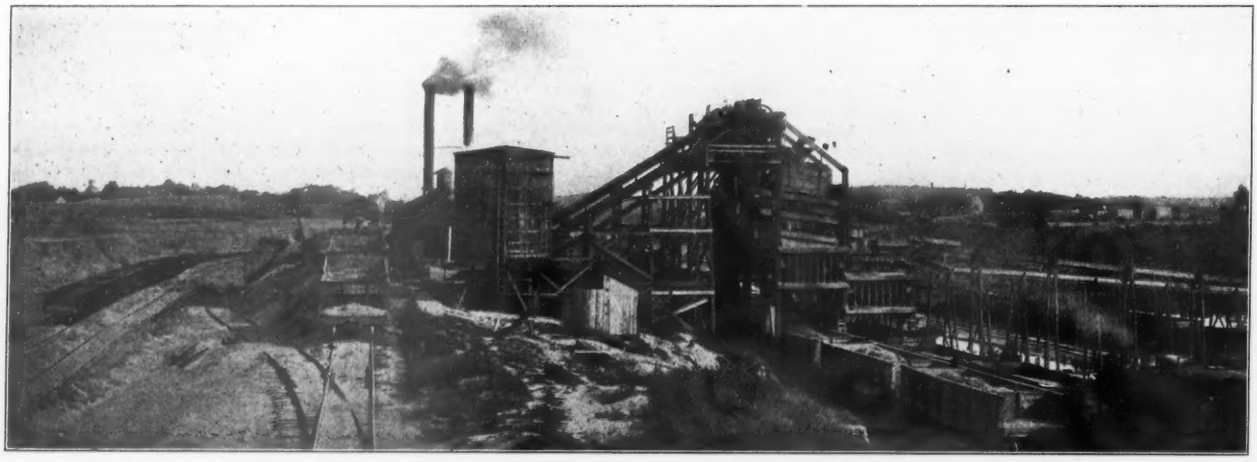
Both engines were of same type and close in succession, hence the same tracing is used for both, but the Clay was a Harrisburg & Lancaster Railway engine, and passed into the possession of the P. R. R. Company in 1850, seven years before their purchase of the Penn. I should have called attention to this on the tracing so that the "P. R. R.—No. 1" would not have been incorporated with the name of the William Penn.

C. H. CARUTHERS.

The Lake Shore Gravel Ballast Washing Plants.

The Lake Shore & Michigan Southern now has in operation two plants for washing gravel for ballast. Both are in Indiana, one being about six miles southwest of South Bend, on the Chicago, Indiana & Southern (formerly the Indiana, Illinois & Iowa) and the other at Pleasant Lake on the Ft. Wayne branch of the Lake Shore. Both plants are working satisfactorily and are turning out large quantities of washed ballast.

The Lake Shore is a pioneer in this undertaking. As a result the first plant built was largely experimental and required a number of changes in important details before the present satisfactory working was obtained. This first or experimental plant is the one near South Bend, at Rupel gravel pit. It was built in the spring of 1905 and started work last summer. The Pleasant Lake plant has just recently been completed and embodies the results of a year's experience with the older plant. For that reason the new plant only is described here, with such references to features of the other as are of interest in connection with its development. Both drawings and photographs are shown in illustration.

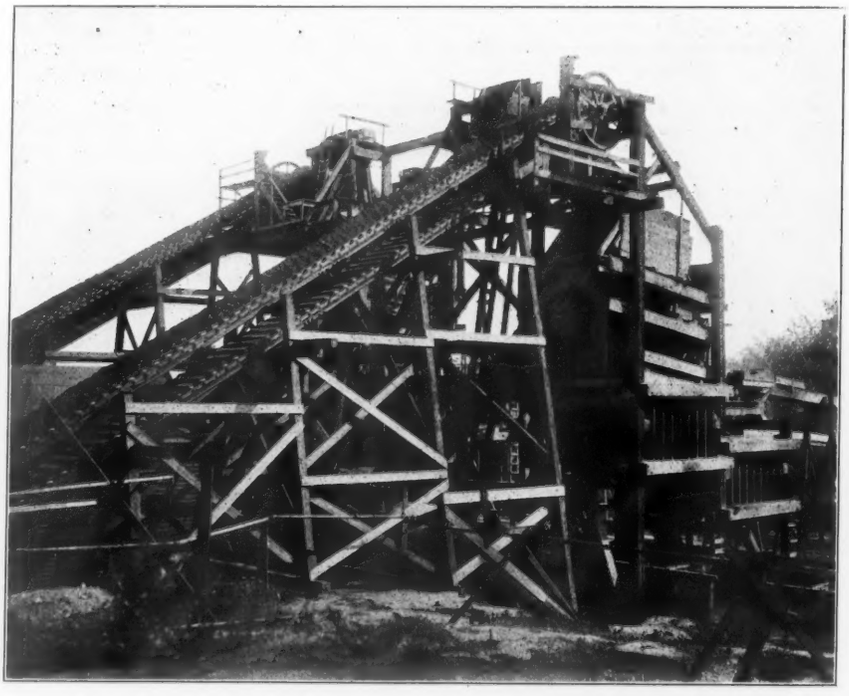


General View of Pleasant Lake Plant, Taken from "Tip-Up."

The chief problem of the undertaking lay in the quantities necessary to be handled to yield an output commensurate with the requirements of the situation, no gravel washing plant for handling materials on anything like the scale required being in existence to serve as a precedent. Calculations for plant proportions were based on the capacity of the gravel pit steam shovel, which is a 3½ yd., 75 ton machine. Referring to the drawings, it will be seen that in general the plant consists of an elevated track from which the gravel cars dump through a hopper on a conveyor delivering at the top of the structure. Meeting the water at this point, the material passes over a series of screens removing all but the sand, which passes into a settler. The sand and washed gravel are caught in hoppers over adjacent tracks, from which they are discharged directly to cars below. The plant consists of duplicate and separately controlled halves, each performing the operations described.

Taking up the operations and plant features in detail the receiving hoppers are so spaced as to enable two cars coupled together to be dumped simultaneously. The gravel cars between pit and hopper are handled by locomotives, two being kept constantly busy at the present rate of working. When the plant runs at a reduced rate one locomotive is dispensed with and the cars are then handled by a single locomotive in conjunction with a "tip-up" beyond the hoppers for switching the empty cars onto a track alongside the hopper track, to be drawn out later by the locomotive. The approach to the hoppers has a 2.3 per cent. grade and the hopper track has a 1 per cent. grade of opposite sign. For the one-engine handling, the gravel cars, as soon as emptied, are pushed one at a time down a 5 per cent. run-off which ends in the tip-up, having an 18 per cent. gradient and sufficient length to bring a single car to rest. The car rolls off of the tip-up through a switch onto the empty-car track. The receiving hoppers are wood, lined with sheet steel, and the pit walls and bottom are concrete. The track rails rest each on a pair of 9 in. x 18 in. timbers bolted together, supported at each of two intermediate points by a pair of 15-in. 45-lb. I beams.

The conveyor, installed by the Link-Belt Company, has a maximum capacity of 4,000 yds., or approximately 200 cars, of gravel per day of 10 hours. The "raw" gravel and water are discharged together on a flume 6 ft. wide and 8 ft. long, the water being delivered through a 8 in. pipe and a special sort of nozzle of the "duck-bill" type, of sufficient spread to cover the flume. The flume discharges on a bar screen and a ¾ in. mesh wire screen immediately beneath and parallel to it. The bar screen, which has a spacing of 2 in. between flats, removes all stones above that size and discharges them into a chute leading to the rock crusher located near the center of the structure. The crushed stone is delivered

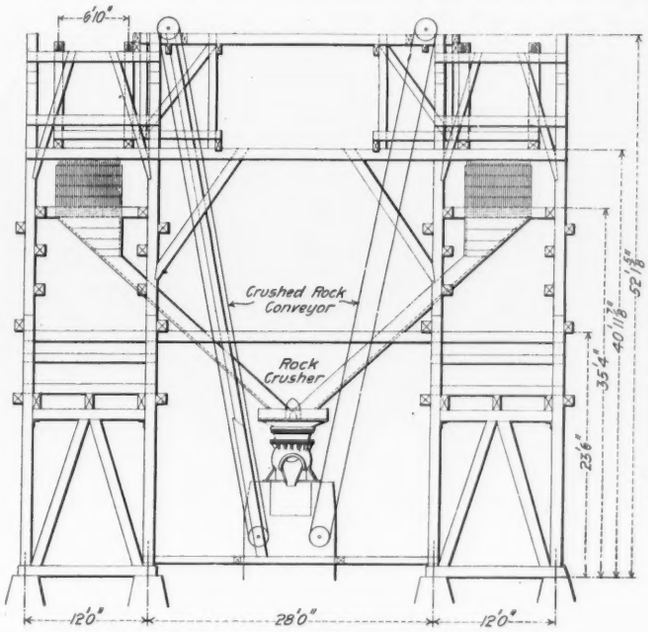


Pleasant Lake Plant from Conveyor Side.

to a bucket elevator of the grain-carrying type, which discharges it into the raw gravel again on the first flume. The materials pass by successive stages over a ¼ in. mesh screen 8 ft. wide and a double screen of 3-16 in. and ⅛ in. mesh, respectively, 10 ft. wide, the last-mentioned being the final or sand screen. The gravel is precipitated into the track hopper so marked and the sand passes on to the settler.

The development of the sand settler was one of the most troublesome features encountered. Several kinds, similar to types

already in use, were tried and proved unsatisfactory, none being capable of passing the immense quantities of sand coming through the washer. Finally the scheme now used was hit upon. It is quite simple in principle, being a sort of funnel arrangement with a valve at the bottom. The sand and water flow into a wooden box which is 6 ft. x 10 ft. at its top and is hoppered down to the funnel mouth, the funnel being made of No. 10 sheet steel. The valve stem is a 1 in. bolt 9 ft. 6 in. long which is threaded at its upper end to carry a hand-wheel for adjusting the valve opening. The valve is supported from a 6 in. x 6 in. timber across the top of the box and is worked by the long wooden lever shown in the elevation of Bent 1. The sand settles down into the funnel while the water flows over the edges of the box on three sides, into troughs which convey it to the waste flume. When a sufficient



Sectional Elevation, Pleasant Lake Gravel Washer.

capacity and this size was therefore chosen in preference to the next smaller having a capacity of only 1,800 gals. The pump and crushed rock conveyor have rope drives.

Stationary screens are used altogether at this plant. This was after trying various kinds of revolving screens at the Rupel plant. At the latter, at the present time, a revolving screen is still used for the initial separation, performed at Pleasant Lake by the bar screen. This revolving screen, made of heavy sheet steel, is 8 ft. long, 4 ft. in diameter and has 2½ in. diameter holes. The service to which the wire screens are subjected is so severe that ordinary screening will not answer at all. The Lake Shore therefore has a screening specially made for this purpose from piano wire. It is rather expensive, but is the only thing that will stand the service.

The Rupel plant is electrically driven throughout, the power being obtained from the high tension line of the South Bend Electric Company. Three-phase current is received at 13,000 volts and is transformed down to 460. The electric operation is more satisfactory in many ways than the steam engine and belt and rope driving, and in this respect the Rupel plant has the advantage of the newer one.

As indicative of the output of the two plants, the figures for the week ending July 27 represent average present performance.

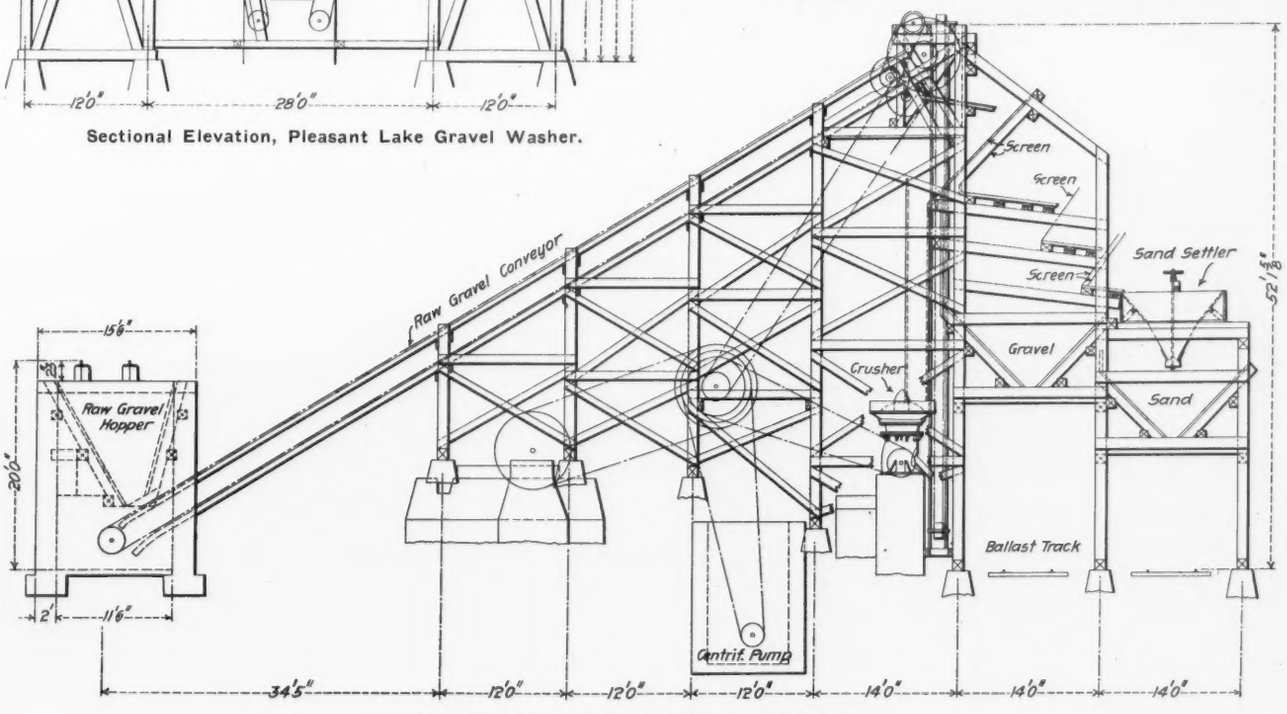
Rupel Pit.

Raw gravel into washer	12,825 yds.
Washed gravel delivered	8,050 "
Sand received from washer	4,775 "

Pleasant Lake.

Raw gravel into washer	19,624 yds.
Washed gravel delivered	8,010 "
Sand received from washer	11,100 "

There are required in the operation of the Pleasant Lake plant a foreman and his clerk, an engineer, fireman, shopman, carpenter, two men on the sand settlers, four laborers to unload the raw gravel, four men below on the loading tracks to keep them clean, and ten car men, which include car repairers and a force to pack the cracks of the wooden cars with marsh hay to prevent serious losses of the finer gravel and the sand in transit. Four locomotives are required, two on the hopper track for delivering to the washer, and two at the bottom for the washed ballast cars. Then there is, of course, the steam shovel and its crew, and a section gang averaging



Side Elevation, Pleasant Lake Gravel Washer.

depth of sand has accumulated in the settler the attendant opens the valve and allows it to flow into the hopper below. Or, if desired, the valve opening can be adjusted and the handle secured in position to permit a continuous discharge of the sand.

The plant is driven by a 200 h. p, Erie steam engine. Water is supplied by a Worthington 10 in. single-stage centrifugal turbine pump, rated at 2,400 gals., against a 90 ft. head. The pump has a 16 in. suction 750 ft. long and 12 ft. lift. A test of the engine driving the pump only, showed that 105 i. h. p. was required for that service alone. The total load on the engine driving the entire plant was 132 h. p. The pump capacity does not, however, indicate the daily water consumption, which has been estimated not to exceed 1,650 gals. But it was thought wise to provide ample pumping

30 men. The total operating cost is about $250 per day for ten hours, and the cost of the washing plant was approximately $25,000.

In order to arrive at an approximate net price per cubic yard for washed gravel, it will be necessary to determine a daily sinking fund and interest charge to be added to the operating cost given above. For this purpose certain assumptions are made below regarding pit and equipment costs for such a plant, many items of which are affected by local conditions to an extent that make any figures here set down of general value only.

Assuming the net cost of the land to be $15,000, and a five-year life on this, the sinking fund charge against same is $3,000 a year. Other items to be distributed over the five-year period are: Cost of grading, $10,000; bridge work, $2,500; miscellaneous, $5,000.

Assume the cost of track to be $36,000 and a 10 per cent. depreciation, and a 15 per cent. depreciation on the washer. The yearly sinking fund items are then as follows:

Plant—15 per cent.	$3,750
Track—10 per cent.	3,600
Grading—20 per cent.	2,000
Bridging—20 per cent.	500
Miscellaneous—20 per cent.	1,000
Land	3,000
Total	$13,850

The working season in Indiana is about 200 days, making the daily sinking fund charge about $70. The interest charge on the investment at 5 per cent. is approximately $20 a day, so that we have:

Operating expenses per day	$250
Sinking fund charge	70
Interest charge	20
Total daily cost	$340

The maximum daily capacity of a plant this size is 1,500 yds., and on this basis the cost per yard is 22.7c. There is a stripping cost at Pleasant Lake which, distributed over the average depth of gravel, amounts to about 6.5c. a yard, bringing the total cost up to slightly over 29c. a yard for the washed ballast on the car. This is without assigning any value to the sand, which sells at a good price wherever there is a market for building sand. At Pleasant Lake the sand averages one-half or more of the output, and if a market can be found for it, the cost of the ballast would be reduced by just so much. As the cost of crushed stone is 50 to 75c. a yard, depending on the locality, it will be seen that the cost of the washed gravel is very much less than rock ballast, even where there is no profit from the sand.

The Lake Shore is engaged in applying the washed gravel this year to its main lines as a light surfacing lift, which serves primarily as a dust-covering. Up to August 1 approximately 112 miles had been covered, the work, part of which was done last year, starting from the Chicago end. It is expected to complete this first lift to Toledo this year. A force of about 50 men per ballast train is required to dig out the old and distribute the new ballast. From three to four trains of the washed ballast, of 20 to 25 cars each, are distributed daily from each plant, a car covering on the average about 125 ft. of single track on double-track right-of-way, or about 1,200 yds. to the mile. It is expected to go over the line next year and give it about a 6 in. raise on the washed ballast, which will practically double the amount now being applied per mile of track.

We are indebted to Mr. S. Rockwell, Chief Engineer of the Lake Shore, and to Mr. H. H. Ross, Assistant Engineer, for courtesies extended in connection with the preparation of this article.

Lucius Tuttle.

The alleged domination of the Boston & Maine in politics has become more or less of an issue in this year's campaigns throughout northern New England. Because the issue here differs from those of states like New Jersey and Wisconsin in being against a railroad rather than the railroads, a man at the head of the corporation in question becomes a figure of almost national importance.

Lucius Tuttle, the President of the company, was born at Hartford, Conn., March 11, 1846. His father was described as a farmer, but the boy never worked a day on the farm, and at 19, after graduating from the Hartford High School, became clerk to the probate judge of the county. Political misfortunes overtook his chieftain a year later, and the young man before he was quite 20 years old found his vocation and became a clerk in the ticket office of the Hartford, Providence & Fishkill Railroad. In this humble position he evidently showed his ability, and the great capacity for organizing, which has been characteristic of his later years, for within the year he was promoted to the office of general ticket agent. When the Hartford, Providence & Fishkill was absorbed by the New York & New England he came to Boston as Assistant General Passenger Agent. In 1878, when the Eastern Railroad was struggling to regain the prestige which had been shattered by the terrible disaster at Revere, Mr. Tuttle was appointed General Passenger Agent of that road.

The Eastern had at that time a most valuable passenger traffic along the coast of Massachusetts, New Hampshire and Maine. The stock of the railroad, after the appalling cost of the Revere calamity, had fallen to about $7 a share. During the five years of Mr. Tuttle's administration of the passenger department, the road recovered its high standing and resumed moderate dividends, and when the consolidation took place with the Boston & Maine in 1883 the Eastern was taken in on the basis of par. The stock now sells at $165. In February, 1884, Mr. Tuttle abandoned this road, of which he was destined to become the head, and became General Passenger Agent of the Boston & Lowell. This road (which was later also leased by the Boston & Maine) formed a very important link in the through line between Boston and Canada, and it was therefore by a natural transition that in 1886 he became General Passenger Traffic Manager of the Canadian Pacific, with headquarters at Montreal. Here the field of his operations was greatly enlarged; hitherto, although handling in the aggregate great volumes of traffic, he had been confined to comparatively short lines and the details related to suburban rates, commutations, and frequent trains in thickly settled districts. In his connection with the great transcontinental system, with its widely scattered stations, few but costly trains, the problem was entirely different. Nevertheless, with his power of organization he achieved great things.

In 1889 when the Trunk Line Commission was established Mr. Tuttle was made the Commissioner of Passenger Traffic, associated with Albert Fink, the Commissioner of Freight Traffic. This position, although considered highly honorable and influential and certainly very lucrative, was not altogether congenial to Mr. Tuttle. In 1890, Mr. Tuttle left the commissionership to become General Manager of the New York, New Haven & Hartford at New Haven. It is worth noting that in exactly 25 years he had completed a circle, beginning at Hartford as a clerk, progressing through Boston, Montreal and New York, always on the up-grade. He arrived at New Haven, and for the first time in his career dropped the qualifying word "passenger" from his official title.

The road to which Mr. Tuttle now came had, during his service elsewhere, absorbed his old employers, the New York & New England, including his first friend, the Hartford, Providence & Fishkill, and had a virtual monopoly of the transportation of southern New England. In 1892 Mr. Tuttle was made Vice-President, and it seemed probable that he would round out his career on the New Haven road.

But in the meanwhile the Boston & Maine system also had been growing, and the deaths of Frank Jones and James T. Furber had left it practically without a head. In 1893 Lucius Tuttle was unanimously elected President. It was some years before the public waked up to the ability of the man. One by one all the railroads of northern New England have been absorbed or taken in control of the Boston & Maine until now it is all-powerful in Vermont, New Hampshire, Maine and Massachusetts north of the Boston & Albany dividing line.

Probably the most conspicuous thing accomplished by Mr. Tuttle since he became President 13 years ago was the leasing of the Fitchburg Railroad in 1900. This lease required the consent of the Legislature. The state of Massachusetts, which built at tremendous expense the great tunnel through the Hoosac Mountain for the avowed purpose of preventing monopoly and maintaining competition in the interests of her commerce, had after some years of unsuccessful operation by the state of the short line of railroad connecting the Fitchburg at Greenfield with the Troy & Boston, sold the "great bore" to the Fitchburg Railroad, taking in payment certain shares, common and preferred, of the road. These shares constituted a controlling interest, which it was necessary to vote in confirming the lease which the directors of the two roads had negotiated. Mr. Tuttle finally persuaded the Legislature and the Governor of the great advantage to the state in transferring this costly white elephant to the corporation which he represented, and finally offered to buy outright the state stock, which had but little value except for its voting power. Mr. Tuttle is a facile after-dinner speaker, with a strong sense of humor. Physically, he is imposing. Standing a trifle over 6 ft., he weighs about 250 lbs., but is very agile and alert in his walk and movements. His eyes are keen, and are said to indicate a capacity for language, which he certainly possesses in a marked degree, being a facile writer and rapid talker, the despair of any but the most expert stenographers. His jaws are strong and well formed; nose shapely and prominent; he wears large glasses to read or write, but not on the street.—*New York Evening Post.*

Foreign Railroad Notes.

The commissioner of Commerce of Burma strongly urges that a railroad be built into western China, as the present pack animal transit system collapses for a third of the year owing to the rains.

The recent decision in the case of the Brighton Railway Company (England) and the Sutton Water Company recalls a rather interesting case which occurred when the canal between Rochester and Gravesend was constructed. Just beyond Strood the canal passed through a tunnel of over a mile in length, now occupied by the South-Eastern Railway. Part of the hill consists of solid chalk, while the end nearer Rochester is chalk and flints. But when the canal was completed, and the salt water of the Medway was admitted to fill it, it was found that the wells in the neighborhood became strongly brackish. An action was brought in respect of the nuisance created. The canal proprietors, of course, denied liability; but during the trial it became evident that through no fault of the contractors a kind of endosmosis had taken place along the lines of flint and the canal company had to pay a very heavy compensation.

Acceleration, and Some Locomotive Problems.*

BY WILLIAM G. RAYMOND.

There are certain locomotive problems of interest to the railroad locating and maintenance engineer, which involve the tractive power of the locomotive, train resistance, and the general principles of accelerated motion.

The most important of these problems are:

1. To determine the load a given locomotive can haul on a given grade at a given constant velocity.

2. To determine the distance on a given grade required by a given locomotive with a given load, to increase or diminish its speed from one given velocity to another.

3. The time required to produce this change in velocity.

4. The converse of 2, to determine what velocity can be acquired by a given locomotive with a given load in a given distance, on a given grade.

5. To determine the length of grade steeper than that for which a locomotive is loaded that can nevertheless be ascended by the aid of a run at the hill. This is the problem of velocity or momentum grades.

6. To determine the speed of a given locomotive with a given load throughout a given division of track.

7. To specify the principal features of the locomotive to be purchased for a given service.

In all these problems certain data which in the nature of the case are to some extent indeterminate must be assumed to be exactly known, and certain other conditions must be assumed that in reality never exist, with the result that practically all of the determinations are approximate and must be considered to be of the nature of carefully prepared estimates. This is particularly true in developing formulas applicable to different locomotives for which the several constants have not been determined by road tests.

ACCELERATION.

Accelerated motion plays an important part in practically all of these problems, and there follows a brief statement of principles and the development of working formulas.

By the property of inertia, all bodies tend to stay in that condition of motion in which at any instant they may be. An accelerating, retarding or deviating force must be applied to change the condition of motion as to velocity or direction.

It is known that a constantly applied force of given magnitude will produce a uniformly changing condition of motion. The rate of change is called the acceleration and may be positive or negative (retardation). It is known also that the acceleration of a given mass is proportional to the magnitude of the constant unbalanced force acting. Thus, if w be the weight of a body, i.e., the measure of the force of gravity acting on it, and g be the acceleration due to gravity, and if P be any other force applied to the body, the acceleration a, produced by P, will be given by

$$a = \frac{P}{w}\, g \qquad (1)$$

from which the force P necessary to produce the acceleration a in a body of weight w is

$$P = \frac{w\, a}{g} \qquad (2)$$

Under the influence of the force of gravity the velocity of a falling body increases g feet per second, g having a value varying with the distance from the center of mass of the earth and with latitude, but usually assumed for mechanical problems as 32.16. If the body start from rest it will have a velocity of g feet at the end of the first second, its average velocity for the first second will therefore be $\frac{g}{2}$ feet, which will also be the space covered in the first second. At the end of t seconds the velocity will be t g feet per second, the average velocity will have been $\frac{t\, g.}{2}$ and the space passed over will therefore be $\frac{t\, g}{2} \times t = \frac{t^2 g}{2}$ feet. If v be velocity in feet per second, t be time in seconds, and h the space or height of fall,

$$v = g\, t \qquad (3)$$

$$h = \frac{g\, t^2}{2} \qquad (4)$$

Since from (3) $t = \frac{v}{g}$, substitution in (4) gives

$$h = \frac{v^2}{2\, g} \qquad (5)$$

Perfectly analogous to these equations, if P be a force acting on a body and producing an acceleration of a feet per second, for t seconds, covering a space of l feet

$$v = a\, t \qquad (6)$$

$$l = \frac{a\, t^2}{2} \qquad (7)$$

$$l = \frac{v^2}{2\, a} \qquad (8)$$

If a body be uniformly accelerated in a distance of l feet from rest to a velocity of v feet per second, the acceleration from (8) is

$$a = \frac{v^2}{2\, l} \qquad (9)$$

and the force P necessary to produce this acceleration, given by substituting for a in (2), its value from (9), is

$$P = \frac{w\, v^2}{2\, g\, l} \qquad (10)$$

If the velocity is expressed in miles per hour V

$$v = \frac{5280\, V}{3600}$$

and

$$P = \frac{w}{2\, g\, l} \times \left(\frac{5280\, V}{3600}\right)^2$$

and if the weight is expressed in tons W of 2,000 lbs.

$$w = 2{,}000\ W$$

and

$$P = \frac{66.9\ W\ V^2}{l} \qquad (11)$$

If a train be the body, P is the tractive effort to be exerted by the locomotive to produce the velocity of V miles per hour in the distance of l feet.

But not only is the train given a velocity of translation, the wheels are given a velocity of rotation, requiring P to be larger than indicated by the foregoing expression by an amount depending on the relative masses of car and wheels, the pattern of the wheels and the velocities. For any given set of conditions the addition to P may be determined by comparing the energy required to accelerate the car wheels in their motion of rotation with that required to give the resulting motion of translation to the car as a whole. No great precision can be attempted for a general formula. The increase of P may be as little as 2½ per cent., and it may be as high as 6 or 8 per cent. over that given by equation (11). Adopting 4.63 per cent. for simplicity of result

$$P = 70\, \frac{V^2}{L}\, W \qquad (12)$$

This force P must be in excess of the forces necessary to overcome all other resitances. It is probable that no train is uniformly accelerated from rest to any given velocity it may attain, because from a velocity of 0 + to five or six miles an hour the pull an engine exerts is nearly constant and is the tractive effort of adhesion,* while the resistances to motion rapidly decrease, leaving an increasing portion of the tractive effort for acceleration. When the velocity of five or six miles is exceeded the resistances to motion slowly increase, the tractive effort decreases, and there results a decreasing force available for acceleration, decreasing somewhat more rapidly than in proportion to the increase of velocity.

If the velocity is to be increased from V_1 miles per hour to V_2 miles per hour, the force required is

$$P = 70\, \frac{W}{l}\, (V_2^2 - V_1^2) \qquad (A)$$

If the force be known, and it is desired to determine the distance required to increase the velocity from V_1 to V_2 miles per hour,

$$l = 70\, \frac{W}{P}\, (V^2_2 - V_1^2) \qquad (B)$$

If the distance and available force are known, and it is desired to know how great a load can be carried with the required acceleration, solve A or B for W and get

$$W = \frac{P\, l}{70\, (V_2^2 - V_1^2)} \qquad (C)$$

If W, P, l and V_1 are known, and V_2 is desired, solve for V_2 and get

$$V_2 = \pm \sqrt{\frac{P\, l}{70\, W} + V_1^2} \qquad (D)$$

In determining l, since P can never be constant, nor even approximately constant, through any considerable change in speed, it is not uncommon to find l for a change in speed of one mile per hour, using successively V_1, $V_1 + 1$, $V_1 + 2$, etc., as initial speeds, until the required change is reached, when the sum of the several values

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*This statement may be questioned. The Pennsylvania Railroad testing department, in its estimates of maximum tractive effort of simple locomotives, counts on only 80 per cent. of the boiler pressure as available in the cylinders even at minimum speeds. If this allowance is correct, probably no simple locomotive in common use can ever exert its full tractive effort of adhesion, which is usually estimated to be as high as one-fourth of the weight on the drivers for favorable conditions of track, and not usually lower than one-fifth under quite unfavorable conditions.

The Baldwin Locomotive Works states that the initial pressure in the cylinder may vary from full boiler pressure at very low speeds to 85 per cent. of boiler pressure at high speeds of 300 revolutions per minute, and uses rather better than 90 per cent. of the initial pressure when the speed is less than 50 revolutions per minute, indicating that the full tractive effort of adhesion may be realized by the cylinders at very slow speed.

Further road tests are perhaps necessary to establish the facts. The locomotive testing plants thus far devised are not adapted to tests of high tractive effort at slow speed.

of 1 will be the distance required. If $V_2 = V_1 + 1$, equation (B) becomes

$$l = 70 \frac{W}{P} (2 V_1 + 1) \qquad (E)$$

The load W in any problem likely to arise would be known or assigned from some estimate made as hereinafter indicated. The tractive effort P must be estimated by subtracting from the estimated total tractive effort of the locomotive, the resistance due to such grade as the train may be on, and the ordinary train resistance, an unknown, and in nature an indeterminate quantity.

Many attempts have been made to determine a rational expression or formula for train resistance, but none has yet been devised, nor is it probable that any simple formula ever will be devised that shall correctly give the quantity known as train resistance. It depends on the condition of the journals and the weight on them, on the condition of the rail surface and the weight on it, on the pattern of the wheels, on the condition of the roadbed, on the temperature, on the velocity and direction of the wind, the speed of the train, etc. It is usually estimated at so many pounds per ton of train, and some of the estimates will be given. Grade resistance, being the action of gravity, on an incline may be determined with precision, and is always proportional to the weight of train.

TRACTIVE EFFORT.

The tractive effort of the locomotive has three limits; it cannot possibly be greater than the tractive effort of adhesion which is the weight on driving wheels multiplied by the coefficient of static friction between wheels and rails; nor can it be greater than the cylinder tractive effort which varies with the steam pressure in the cylinders, the diameter of the pistons, the stroke and the diameter of the driving wheels. If the cylinders are large enough, the drivers small enough, and the steam pressure high enough, the cylinder tractive effort would equal the tractive effort of adhesion, and the locomotive should be so designed that this is the case at low speeds. As the speed increases the effective pressure in the cylinders falls, and the full tractive effort of adhesion cannot be had; moreover, with such boilers as have as yet been devised, the supply of steam at high pressure necessary to give the full tractive effort of adhesion cannot be maintained at high speed.

A boiler is capable of developing a more or less definite horse-power, and if the work performed is performed at high speed, the force exerted must be relatively small if the power exerted remains constant. Thus we have the boiler tractive effort as the limiting quantity at anything over the lower speeds of from six to ten miles an hour, the precise limit depending on the design of the locomotive.

The coefficient of static friction between wheel and rail is usually estimated at about one-fourth for favorable conditions, as high as one-third with a sanded dry rail, and as low as one-fifth or less for ordinary winter conditions.

In determining P, therefore, for low speeds under six miles an hour, either the tractive effort of adhesion, i.e.,

T_a = weight on drivers × coefficient of friction

or the cylinder tractive effort should be used, and for higher speeds, either the cylinder tractive effort or the boiler tractive effort. It is practically always true that boiler tractive effort must be used at speeds of over eight to ten miles an hour. In any event, the tractive effort that is smallest must be used.

Cylinder tractive effort is given by the formula

$$T_c = \frac{C^2 L p}{D} \qquad (F)$$

in which C is the diameter of the piston in inches, L the stroke in inches, p the mean effective pressure in the cylinder in pounds, D the diameter of the drivers in inches, and T_c the tractive effort in pounds.

The boiler tractive effort is given by

$$T_b = \frac{375 \text{ I H P}}{S} - F \qquad (G)$$

in which I H P is indicated horse-power, S is speed in miles per hour, F is the machine friction reduced to pounds of tractive effort, and T_b is the tractive effort in pounds. The first term of this formula, although not new, is not so generally known but that its derivation may be given.

One horse-power is 33,000 ft.-lbs. of work per minute, or 60 × 33,000 ft.-lbs. per hour. Assuming no losses from friction the tractive effort multiplied by the distance through which it acts in a given time equals the work done in that time, and this divided by the foot-pounds of work corresponding to one horse-power for the given time, should be the horse-power developed by the locomotive. Therefore

$$\frac{T_b \times S \times 5280}{60 \times 33000} = \text{I H P or}$$

$$T_b = \frac{375 \text{ I H P}}{S}$$

And since there are losses due to friction of the machine parts that friction must be deducted, giving equation (G).

The horse-power of a locomotive is not usually given, but if not known it may be estimated from the heating surface.

The maximum power per square foot of heating surface varies with the design of the locomotive, but recent tests* seem to indicate that simple freight locomotives developing full power produce one cylinder horse-power for each 2.3 sq. ft. of heating surface, varying somewhat either side of this average, and that compound locomotives may produce one cylinder horse-power for each 2 ft. of heating surface with very decided variation either side of this mean value. Thus, for a simple freight locomotive, the boiler tractive effort may be expressed by

$$T_b = \frac{375 \times \frac{H}{2 \cdot 3}}{S} - F = \frac{163 \text{ H}}{S} - F$$

in which H is square feet of heating surface and F includes the rolling resistance of the drivers. F varies with the speed between limits of 6 per cent. and 25 per cent. of the indicated power, but with the locomotive developing full power, or a little less, it may fairly be taken at 10 to 12 per cent. for estimates. In round numbers, therefore, the boiler tractive effort is

$$T_b = \frac{145 \text{ H}}{S} \qquad (H)$$

GRADE RESISTANCE.

Grade resistance, in pounds per ton of train, is given by

$$R_g = 20 \text{ r}$$

in which r is the rate of rise in 100 feet, or the rate per cent. of the grade. It is a resistance or retarding force to an ascending train and an accelerating force to a descending train.

TRAIN RESISTANCE.

The work done in drawing the train behind the tender on a straight, level track, is the product of the quantity called train resistance and the distance through which the train is drawn. Train resistance is usually considered to include all resistance taxing the tractive effort of the drivers, except grade and curve resistances. It includes the rolling resistance of the driving wheels, which in later estimates, because of the character of locomotive testing plants, is included with the machine friction. Train resistance arises from (1) journal friction; (2) rolling friction or resistance; (3) resistance due to oscillation and concussion; (4) head, tail and side resistance of the atmosphere.

Journal friction is a maximum of 15 or 20 lbs. per net ton at a velocity of 0 + just after starting from rest; it is not nearly so much when slowing down from motion to 0 + or after a momentary stop. From this maximum it falls rapidly as the velocity increases to an unknown minimum possibly approximating 2 lbs. per ton. It is very much affected by temperature, and if a minimum of 2 lbs. is realized in summer temperature, it is very probable that the minimum may be 4 to 6 lbs. in winter weather. It varies very little with velocity if the speed is above six or eight miles an hour. It depends very much on the character of the lubrication and the condition of the bearings.

Rolling resistance is unknown in amount and is usually classed with journal friction. It doubtless varies much with the condition of the track, and with the insistent weight, and is little affected by velocity changes. Rolling resistance and journal friction together are assumed at from 2 to 3 lbs. per net ton in modern expressions for train resistance.

Resistance due to oscillation and concussion is unknown in amount, is believed to be very small, and probably varies with the square of the velocity.

Atmospheric resistance has been most thoroughly investigated by Professor Goss at the Purdue laboratory. Much depends on the form of the cars and the make-up of the train. A freight train of box cars moving through still air seems to be resisted by a force given by the expression $A = (13 + .01\ C)\ V^2$, C being the number of cars in the train. For the engine and tender alone $A = .11\ V^2$ and for the train alone $A = (.016 + .01\ C)\ V^2$. For passenger trains the coefficient of C is to be doubled. At ordinary freight train speeds the whole quantity is small, but at high velocities the resistance is considerable, consuming from 10 to 20 per cent. of the tractive force of the locomotive. The foregoing values are for motion through still air. A head wind of velocity equal to that of the train would increase the resistance four times, a side wind would have an unknown effect which would be quite large.

Summarizing all we know of train resistance, it is probable that the whole may be represented by an equation of the form

$$R = \left(A + B\,V + \frac{C}{(V + K)^2} + D\,V^4\right) W + M\,V^2$$

in which R is the total resistance in pounds, A, B, C, D, K and M are coefficients, some of which may be zero, to be determined by experiment, W the weight of the train, and V is the velocity in miles per hour. W being expressed in tons, the parenthesis gives the resistance in pounds per ton of train, which is the usual way of stating it.

The commoner formulas for train resistance are much simpler than that just given.

*Pennsylvania Railroad tests at the Louisiana Purchase Exposition, which seem to confirm earlier results of Professor Goss.

The Baldwin Locomotive Works formula is

$$R_T = 3 + \frac{V}{6}$$

in which R_T is resistance in pounds per ton of train and V is speed in miles per hour.

The *Engineering News* formula is

$$R_T = 2 + \frac{V}{4}$$

These formulas make no allowance for the fact that loaded trains have a less resistance per ton than empty trains, and they also probably include the machine friction of the locomotive. In using these formulas in connection with the boiler tractive effort, the undiminished value of the tractive effort should be used, namely

$$T_b = \frac{163\ H}{S} \text{ or } \frac{375\ I\ H\ P}{S}$$

Formulas that are perhaps better for freight train resistance are those devised by Mr. Sanford L. Cluett to fit the curves of the late Mr. A. M. Wellington; they are

$$\text{For empty trains } R_T = 5.4 + 0.01\ S^2 + \frac{70}{(S+3)^2}$$

$$\text{For loaded trains } R_T = 3.8 + 0.0076\ S^2 + \frac{16.4}{(S+1)^2}$$

The formulas give results probably much too great for high speeds, and possibly somewhat too high for all speeds. The following modifications are suggested, and while less simple than the *Engineering News* or Baldwin formulas, they are believed to fairly well fit freight train resistance curves, not including machine friction, and are applicable for speeds of from 0 + to about 35 miles an hour.

$$\text{Loaded train } R_T = 3.5 + 0.0055\ S^2 + \frac{16}{(S+1)^2}$$

$$\text{Empty train } R_T = 5.0 + 0.007\ S^2 + \frac{8}{(S+1)^2}$$

CURVE RESISTANCE.

Curve resistance is usually estimated at about one-half of a pound per ton of train per degree of curve. That is, a 4 deg. curve will offer a resistance of ½ lbs. for each ton of train on the curve.

SOLUTION OF PROBLEMS.

Having stated the fundamental formulas, it remains to indicate their use in solving the problems mentioned in the beginning of this paper.

In advance, one formula for train resistance is adopted and diagrammed or tabulated so that the resistance for any speed may be taken at once from the diagram or table. It will perhaps be best if several diagrams or tables are made for various percentages of loading on the train, the several curves for partial loading lying between the curves of loaded and empty trains.

Next, for the particular locomotive to be discussed, a diagram or table of tractive effort should be made, using the boiler tractive effort formula for all speeds above that for which the boiler tractive effort equals the cylinder tractive effort, using, say, 80 per cent. of boiler pressure as mean effective pressure in the cylinder formula, except that for speeds below five miles an hour 85 per cent. of boiler pressure may probably be safely used. Should the tractive effort of adhesion be less than the cylinder tractive effort that quantity should be used for the lower speeds.

Problem 1. To find the load a given locomotive can haul on a given grade at a given constant velocity. The sum of the resistances must equal the tractive effort; therefore, the tractive effort at the assumed speed should be placed equal to the train resistance and grade resistance, indicated by the weight times the resistance in pounds per ton, and the weight obtained thus:

$$T = W\ (R_T + 20\ r)$$

$$W = \frac{T}{R_T + 20\ r}$$

If r is the ruling grade of the road, T should be taken for the minimum allowable speed; which is placed by different experimenters at from five miles per hour to 10 miles per hour. It should be that speed which is just enough to make stalling from small accidents of firing, or track condition, unlikely. When this speed is used the rating for the locomotive over the division is obtained.

Problem 2. Assuming this load, let it be required to determine the distance on some grade less than the ruling grade in which, if the locomotive exerts its full power, the velocity may be increased by one mile per hour. Again, the net tractive effort must equal the sum of the resistances, including that due to acceleration. The P of equation (E) becomes $T - W\ (R_T + 20\ r)$. T and R_T should be values either for S_1 or $(S_1 + ½)$ or $(S_1 + 1)$. It will be more nearly exact to consider T and R_T the tractive effort and resistance for $(S_1 + ½)$. Then (E) becomes

$$l = 70\ \frac{W}{T - W\ (R_T + 20\ r)}\ (2\ S_1 + 1)$$

$$l = \frac{70\ (2\ S_1 + 1)}{\frac{T}{W} - R_T + 20\ r)} \qquad (I)$$

If it is desired to find the space required to increase the velocity from S_1 to S_2 miles per hour, equation (I) is solved with successive values of S and corresponding values of T and R_T until the value of S_2 is reached; the values of l thus found are added for the required result.

If it is desired to know what average speed may be made up such a grade of length L, equation (I) is solved with successive values of S and corresponding values of T and R until the sum of the several values of l equals the length L; then for an approximate result average the initial and final speeds. For a more exact result each S or each $(S + ½)$ is multiplied by the corresponding l, the products summed, and the sum divided by L. The sum of the l's will probably not just equal L, but extreme precision is useless in such a problem, since the assumed conditions are rarely those obtaining; the whole train does not enter the grade at once, may never be on the grade, and does not leave it at once.

Both of these problems may be approximately solved by using for T and R_T their values for the mean velocity, known in the first and estimated in the second, and substituting the resulting P in equations (B) and (D).

Problem 4. The procedure is as in the last problem, omitting the averaging.

Problem 5. A locomotive and train approaches a grade steeper than the ruling grade for which it is loaded at a speed of S_1 miles an hour, and may leave it at a speed of S_2 (less than S_1) miles an hour. How long may the grade be?

P of equation (B) is now essentially a negative or retarding force, and the parenthesis $(V_2^2 - V_1^2)$ becomes for $V_2 = S_2 - 1, -(2\ S_1 - 1)$ therefore (E) becomes

$$l = 70\ \frac{W}{P}\ (2\ S_1 - 1)$$

and as before P is the difference between T for speed, S_1 or $S_1 - ½$, R_T for the same speed and R_g, or

$$l = 70\ \frac{W}{T - W\ (R_T + 20\ r)}\ (2\ S_1 - 1)$$

$$= \frac{70\ (2\ S_1 - 1)}{\frac{T}{W} - (R_T + 20\ r)} \qquad (K)$$

Solving with successive values of S to S_2 and corresponding values for T and R_T, and summing the results, the possible length of grade is obtained. Again, an approximate solution may be had by substitution in (B), using for P a value obtained by taking T and R_T at their values for the mean velocity on the grade, thus:

$$l = \frac{70\ W\ (S_2^2 - S_1^2)}{T - W\ (R_T + 20\ r)}$$

$$= \frac{70\ (S_2^2 - S_1^2)}{\frac{T}{W} - (R_T + 20\ r)} \qquad (L)$$

If both numerator and denominator of (K) and (L) be divided by 20, there results

$$l = \frac{3.5\ (2\ S_1 - 1)}{\frac{1}{20}\left(\frac{T}{W} - R_T\right) - r} \qquad (K')$$

$$l = \frac{3.5\ (S_2^2 - S_1^2)}{\frac{1}{20}\left(\frac{T}{W} - R_T\right) - r} \qquad (L')$$

But from the equations given under Problem 1

$$T = W\ (R_T + 20\ r) \text{ and}$$

$$r = \frac{1}{20}\left(\frac{T}{W} - R_T\right)$$

is the grade on which with tractive effort T and train resistance R_T, the locomotive can just draw the train at the constant velocity corresponding to T and R_T, and this quantity is seen to be the first term of the denominator in both (K') and (L'). If, therefore, r' be the grade on which the locomotive can just draw the weight W at the mean velocity of $(S_1 + ½)$ or $\frac{S_1 + S_2}{2}$, then (K') and (L') become

$$l = \frac{3.5\ (2\ S_1 - 1)}{r' - r} \qquad (M)$$

$$= \frac{3\ 5\ (S_2^2 - S_1^2)}{r' - r} \qquad (N)$$

The quantity r' may be tabulated in advance for the given locomotive when the problem of determining l for any grade on the road will be a very simple matter. r' is known as the virtual grade.

Equation (I) may be similarly treated and will then become

$$l = \frac{3.5\ (2\ S_1 + 1)}{-r} \qquad (P)$$

Problem 6. This problem is determined by successive solutions of the preceding problems. Assuming the locomotive loaded for

minimum speed on the ruling grade of the division, the average speed that can be made on the several grades is determined taking care that a maximum speed of, say, 30 miles an hour, is never exceeded, and introducing all probable stops, the average speed over the division is then readily determined. This will be in the nature of things an estimate and should be checked by trial on the road.

Problem 7. Problem 7 is quite complex. The method of investigation may be stated somewhat as follows. Determine the load to be hauled on the ruling grade at the minimum speed; from the maximum tractive effort required determine the weight on drivers, and from the allowable unit weight the number of drivers (note that the result is rational and practicable); determine a desirable average schedule time, and with this and some grade on the division assumed at average speed to require the full capacity of the locomotive, and the determined load, estimate the total resistance and the necessary power to overcome this at the assumed speed; with this assumed power, a profile of the division, and the determined load, find the speeds at which the various grades can be worked, compare the resulting average with that deemed desirable and modify the power as may be necessary; determine the heating surface, and approximate dimensions of boiler by comparison with existing locomotives or *de novo;* see that the results are practicable; state the requirements to be a locomotive with the determined weight on drivers and the determined cylinder horsepower, to be developed most economically at the determined average speed, to be capable of such a maximum speed, and with such a maximum cylinder tractive effort as has been determined, and leave the proportioning to the locomotive designer, checking the design in these particulars when it shall be submitted.

Problem 3. The time required to gain the velocity v feet per second from rest, if gained in the distance l feet is

$$t = l \div \frac{v}{2}$$

with v expressed in miles per hour S, since

$$v = \frac{5280}{3600} S$$

$$t = \frac{15}{11} \frac{l}{S}$$

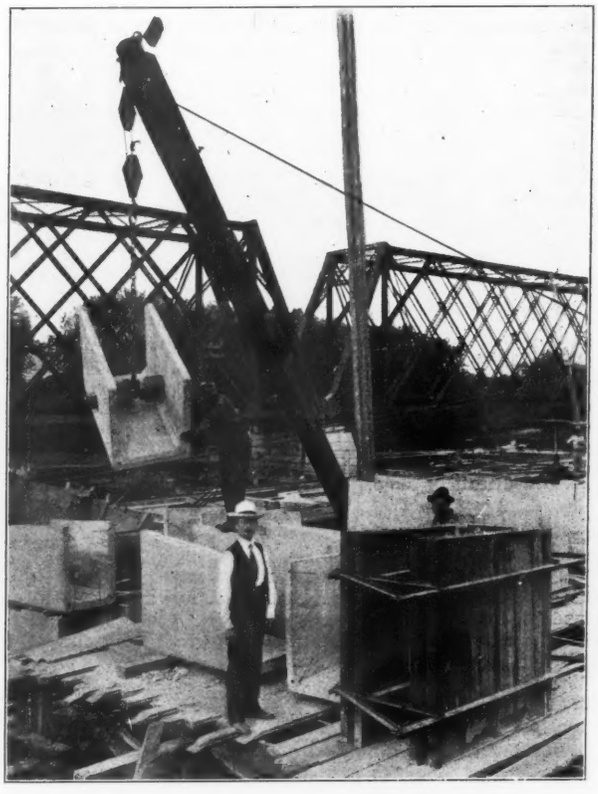
and if the speed is to be increased from S to S_2 miles per hour in the distance l feet, the time required is

$$t \text{ seconds} = \frac{15}{11} \frac{l}{S_1 + S_2} \qquad (R)$$

Hence, having found the distance required for a given acceleration or retardation, substitute it for l in equation (R) and solve for the time.

Strauss Ribbed Concrete-Steel Bridge for the Elgin-Belvidere Electric Railroad.

A reinforced concrete bridge of novel design has just been built near Belvidere, Ill., from the plans of Mr. J. B. Strauss, of Chicago. It is a ribbed concrete-steel structure and embodies fea-



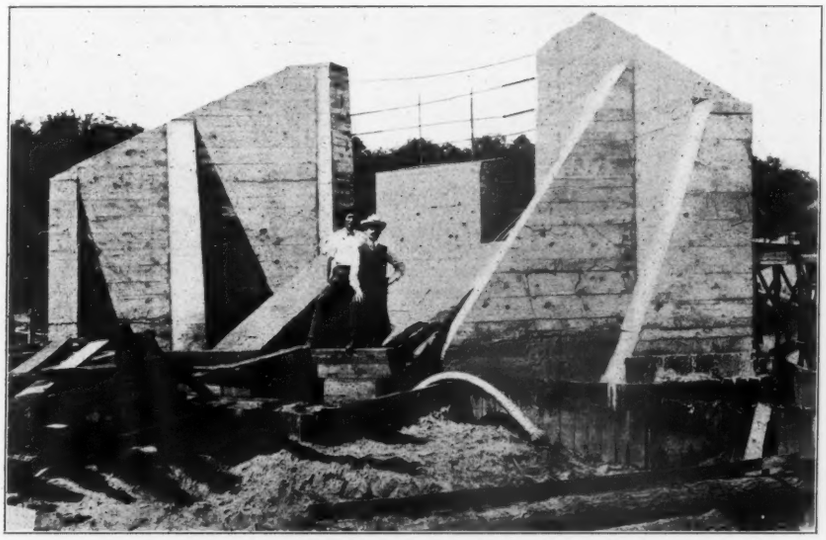
Derrick Handling Sectional Forms; Steel Mould in Foreground—Strauss Ribbed Concrete-Steel Bridge.

North Elevation of Strauss Ribbed Concrete-Steel Bridge near Belvidere, Ill.; All Spans Erected.

tures which have considerably increased the economy of this type of bridge, the first design of which by Mr. Strauss was built in 1905. For the following description of this bridge, which is a single-track structure on the Elgin-Belvidere Electric Railroad, and spans the Kishwaukee river at a point about 2½ miles east of Belvidere, we are indebted to Mr. Strauss.

There are four arches of 81 ft. clear opening, the piers being spaced 87 ft. 6 in. centers. The total length of the bridge is 350 ft. Each arch has a circular intrados with a radius of 83.36 ft. and a rise of 10 ft. 6 in. At low stages of the river the water is about 3 ft. below the springing line, and in extreme stages it rises to within 5 ft. of the intrados of the arch at the crown.

Each span has two arch ribs 8 ft. 10 in. c. to c. The ribs are 2 ft. 6 in. wide throughout, but vary in depth from 3 in. at the crown to 4 ft. 6½ in. at the haunches. Each arch rib carries a



Back View of East Abutments-Strauss Ribbed Concrete-Steel Bridge.

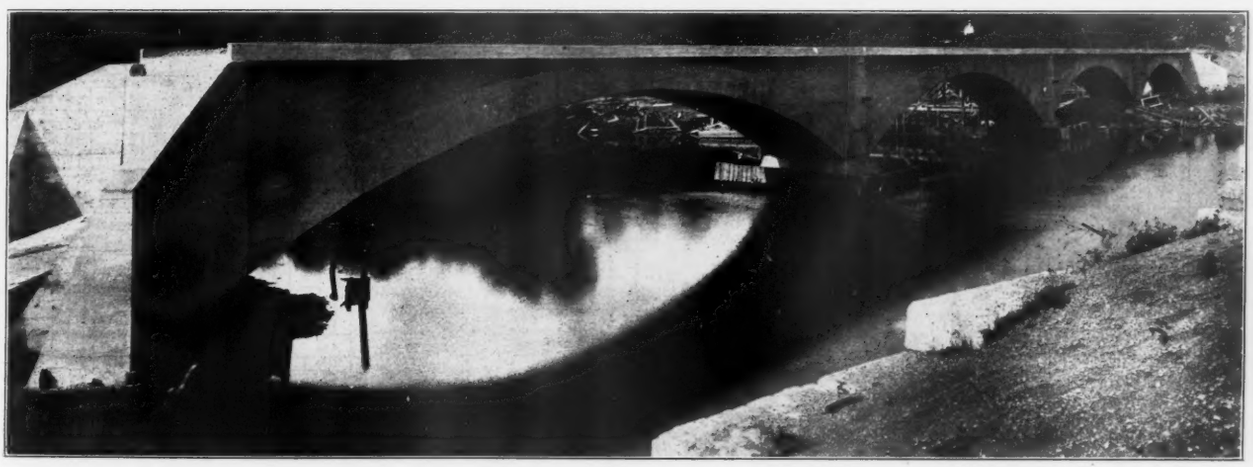
12-in. spandrel wall centrally disposed above the rib and built up to a horizontal plane through the extrados of the arch at the crown. For lateral stiffness the arch ribs are connected by eight 21-in. diaphragms in each span spaced at even intervals along the arch, and on top of these diaphragms 12 in. cross walls are built flush on top with the spandrel walls. On these spandrel and cross walls the floor slabs are carried. These slabs are 14 ft. wide and 6 in. thick, and at the sides there are two 8 in. curbs, whose purpose is to confine the rock ballast of the roadbed. In the floor slab drain holes are provided at intervals as indicated. At each of the piers a pilaster is built to within 3 in. of the ledge of the floor slab, and means provided on this pilaster for the support of the trolley poles. At the abutments are seats for the connection of the trestle approaches.

As far as described, the design follows the lines of the Strauss ribbed bridge, previously referred to, the fundamental feature of which is a series of longitudinal ribs and transverse cross braces. It was in the erection of the bridge that radically new methods were employed, which had for their purpose the elimination of all centering and falsework. In carrying out this plan each arch ring was divided into 17 trough-shaped reinforced concrete sectional forms, 2 ft. 6 in. wide outside and 4 ft. $11^{11}/_{16}$ in. bottom length. The sectional forms at the crown were 3 ft. deep and at the haunches 4 ft. 6½ in., and the intermediate sectional forms graduated from one to the other. The walls of these sectional forms were 3 in. thick and the bottom 4 in. thick, making the core or rib proper 2 ft. x 2 ft. 8 in. at the crown and 2 ft. x 4 ft. 2½ in. at the haunch. The inside corners were filled as shown in the illustrations. The reinforcement of each sectional form consisted of ⅜-in. plain round steel bars, placed 8 in. c. to c. in the direction of the arch, and 12 in. in the opposite direction. The mixture of concrete used was 1:3, very wet, to thoroughly fill the steel moulds in which the sectional forms were cast. The weight of these sectional forms varied from 1,500 to 2,200 lbs. The forms were cast in a series of steel moulds, eight—all alike—being used for the rib forms and two for the diaphragm forms. The steel moulds were built up of 16-lb. sheet steel stiffened by 3-in. channels and held in alinement by angle irons so connected up that the moulds could be readily knocked down and reassembled.

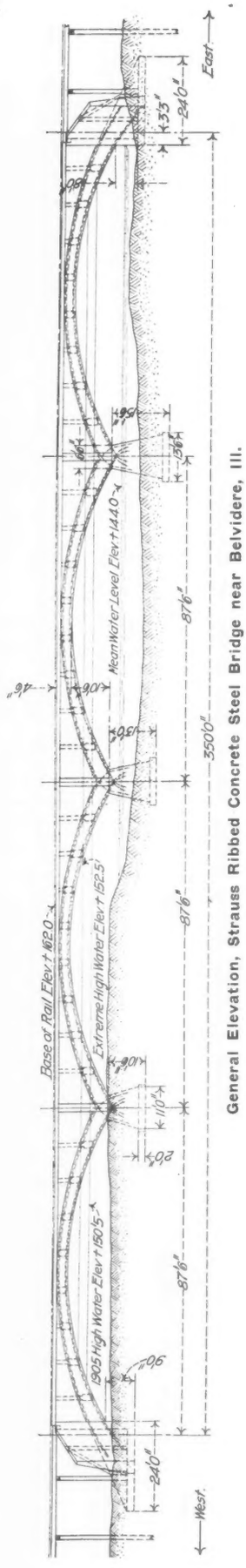
There were 136 rib forms and 32 diaphragm forms to cast. Since each rib was symmetrical about the center only nine different kinds of sectional forms were required for the ribs and one for the diaphragm. These were all cast in the 10 steel moulds, variation in the depth of the rib forms being effected by inserting loose wooden strips in the correct position between the inner and outer side pieces of the mould. The sectional forms were cast with the mould standing vertically, so that one voussoir face was against the working platform on which the mould stood while the other was flush with the top of the mould.

It will be noticed that each sectional form has a hole in each side at about its center of gravity. These holes were for handling. Several of the sectional forms also have two rectangular openings in one wall. These were provided for the diaphragm connections, and all these openings were made by fastening wooden blocks to the mould before the concrete was filled in. The sectional forms hardened very rapidly and it was possible to remove the steel mould 24 hours after the concreting was done. After all the sectional forms had been made they were numbered and stored at the site until ready to be placed in the structure.

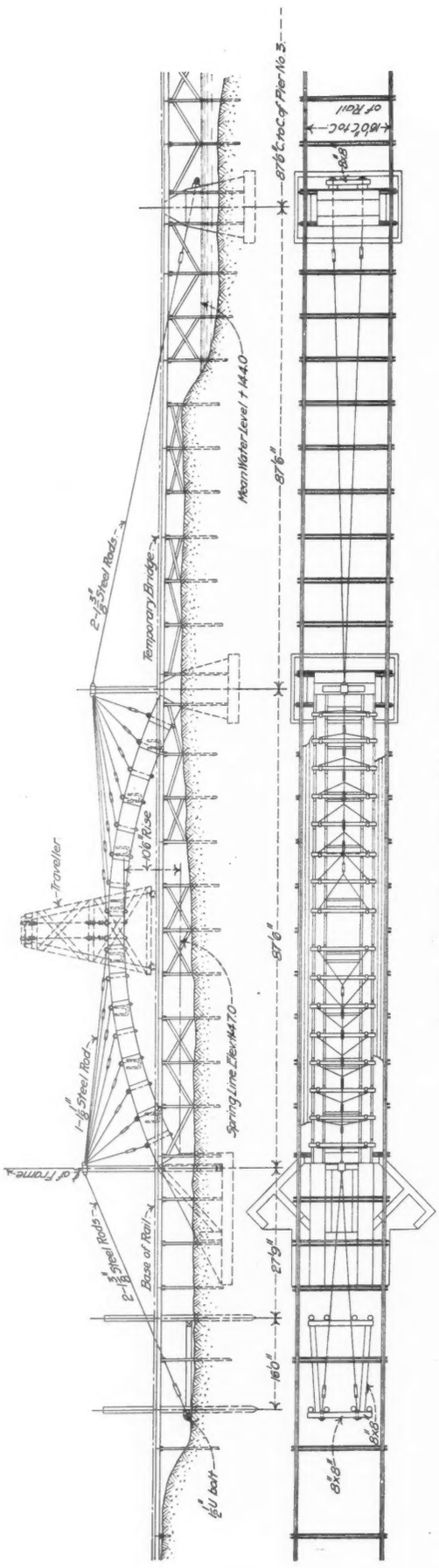
Meantime a light temporary bridge was built by hand-driving two rows of piles on each side of the bridge, capping these with 2 in. x 10 in. transverse planks and bracing them in both directions by 1 in. boards. On top of the piles 6 in. x 10 in. stringers were laid and light rails were spiked directly thereto. On this temporary bridge a light traveler was mounted and fitted with two triplex blocks, each provided with a balance beam made up of two 8-in. channels. In placing the sectional forms in position, they were first moved to a platform on the temporary bridge by means of a guy derrick, then assembled in pairs with a lifting frame of two sets of 4 in. x 6 in. cross timbers, one near each end. These were connected to the forms by means of long bolts passing



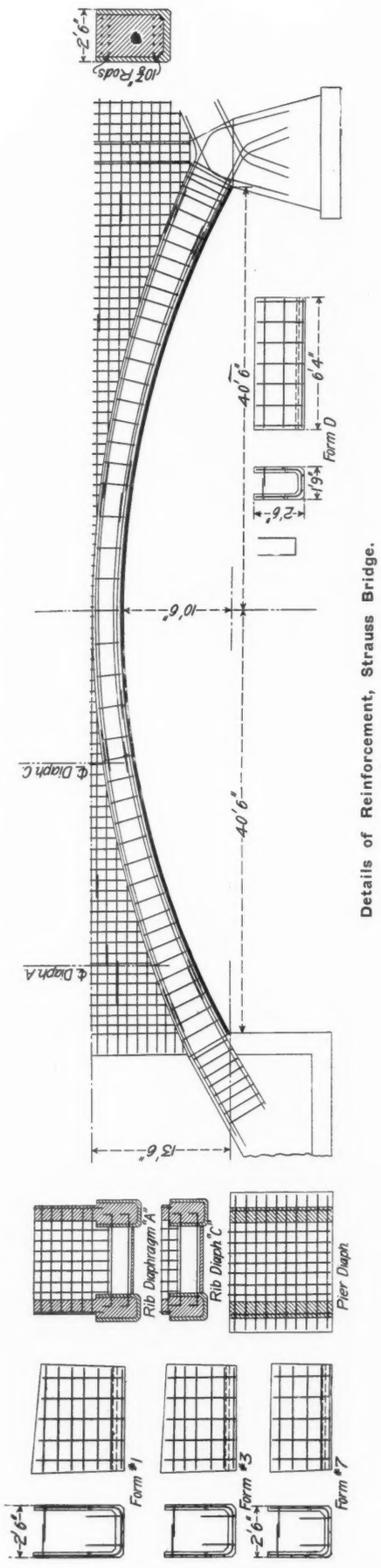
General View of Strauss Reinforced Concrete Bridge at Belvidere, Ill.



General Elevation, Strauss Ribbed Concrete Steel Bridge near Belvidere, Ill.



Erection Diagram, Strauss Ribbed Concrete Steel Bridge.



Details of Reinforcement, Strauss Bridge.

through holes in the bottom of the forms, and at the top were fitted with U bolts, corresponding to the hooks of the balance beams. Two of the accompanying views clearly show how the derrick and traveler handled these sectional forms, one of them also showing one of the steel moulds. Two ribs throughout were erected simultaneously, and where the rib forms were associated with diaphragm forms they were all placed as a unit.

To support the sectional forms in position, two A-frames were built. One of these was set at the abutment and anchored back to the piles of the trestle approach. The other was set on pier No. 1 and anchored back to pier No. 2. The anchors consisted of two 1⅜-in. round steel rods for each A-frame, the rods being in 16-ft. lengths connected by sleeve nuts. Turnbuckles were also provided for adjustment. From the top of these A-frames radiated a series of eight 1⅛-in. round steel rods, each provided with a turnbuckle, and each terminating in two shorter 1 in. rods diverging to the ribs, where they were connected to the U bolts on the lifting frame carrying the assembled sectional forms. In addition to the 4-in. x 6-in. timbers above referred to, two light wooden frames on each pair of forms were used to brace the ribs, and while the lifting frames were removed as soon as the span was completed, the brace frames were left in place until the concrete had been placed in the ribs.

The erection was begun simultaneously from each haunch, the first sectional form being supported on the skewback at one end, and at the other end attached to the first set of A-frame rods as just explained. The second sectional form was then brought into position and supported at one end on the first form, the other end being supported on the second set of A-frame rods. The connection between the sectional forms was made by means of steel dowels placed in gas pipes located in the bottom corners of the forms, and in some cases by means of wooden blocks fitted to the inside of the forms. In this manner the sectional forms were all placed in position and supported. The keystone required no support other than that supplied by the two adjacent sectional forms, and when this keystone had been placed the A-frame rods were slackened and the two halves allowed to close against it. The entire series of sectional forms forming the arch then became self-supporting and the A-frames with their anchors and rods were removed and used for the erection of the next arch in a similar manner. The assumption used in calculating the A-frame rods was that the sectional forms were supported at two points while being placed, and this condition was actually established as explained above. The suspension rods were so adjusted that the joints between the various sectional forms were left open slightly at the top.

To insure the proper fitting of the keystone, the faces of the skew-backs on the piers were dressed before erection was started so as to make the angle between the face of the skew-back and the horizontal plane through the springing line slightly less than that calculated. In addition, the lower edge of the first sectional form was rounded so as to keep the pressure from coming too close to the edge, and a strip of sheet lead ⅛ in. thick was placed in the joint. By means of the turnbuckles on the anchor rods it was possible to raise or lower half of the arch as a unit, the rotation taking place about a horizontal axis near the lower edge of the first sectional form, and the effect was practically the same as if a hinge had been inserted in the joint at the skewback. In this way the opening in the center for the keystone was adjustable, and there was no trouble whatever in fitting the keystone in place. After the removal of the A-frames and supporting rods all the joints were found tightly closed and the alinement was perfect.

After the first arch ring had been completed in this manner it was left without filling in the concrete until all the remaining arches had been completed. This was necessary, as the intermediate piers would not be stable under the unbalanced horizontal thrust caused by placing the concrete in one span before the skeleton arch of the adjoining span was erected. When the four arches were in place the reinforcement was put in position in the hollow ribs. These ribs, together with the diaphragms, were then concreted by first putting in a 12-in. layer of concrete and then following up with the remainder. The concrete in the arch ring and the diaphragms was made continuous by means of the openings through the inner walls of the sectional forms, and the entire construction thus rendered monolithic. After the arch ring had been completed in this manner the spandrel walls and floor were built by means of ordinary wooden forms.

The erection of the arch rings was successfully completed in a very short time notwithstanding the fact that only unskilled labor was employed. It took an average of three days to erect one span and take down and reset the A-frames with their anchorages. The last arch ring was erected in a day and a half, and the largest number of sectional forms placed per day was 12 pairs. The entire superstructure, including the arch rings, was completed in 30 days, which included three or four days delay caused by labor troubles.

The substructure presents no features of special interest. The three intermediate piers were built of solid concrete, while the abutments were provided with buttressed wing walls, which together with the walls and base slab were all of reinforced concrete. With the exception of pier No. 3 and abutment No. 2 the substructure was founded on gravel. At pier No. 3 quicksand was encountered, which caused a great deal of trouble and involved a delay of at least 30 days in the completion of the substructure. Abutment No. 2 likewise gave some trouble on this account. A double-walled cofferdam was finally built around this pier and abutment and piling driven. The cofferdam was then sealed by depositing the concrete under water, after which the construction proceeded in the usual way. The mixture of concrete for the piers and abutments was 1:3:5 and for the superstructure 1:2:4.

The bridge was built for a live load consisting of a train of 40 ton interurban electric cars, and for the following unit stresses:

		Without temperature variations.	With temperature variations, of + or — 40° F.
Concrete:	Compression	500 lbs. per sq. in.	650 lbs. per sq. in.
	Tension	50 " "	75 " "
Steel		10,000 " "	13,000 " "

It will be noticed that the tension in the concrete is kept below the limit where there is any danger of cracking. The stresses were figured for the arch fully loaded and half loaded and were combined with the temperature stresses to produce the maximum. Only the concrete and steel in the core was considered effective, but since the sectional forms actually carry a considerable part of the dead load the factor of safety of the bridge is higher than ordinarily obtains in reinforced concrete construction. The reinforcement in the arch rings consisted of ten ⅞-in. plain round rods in both the extrados and intrados of each arch ring, with shear rods as shown. The ⅞ in. rods were about 30 ft. long and were spliced by overlapping 3 ft. These rods were also continued into the foundation. The reinforcement in the spandrel walls consisted of ⅜-in. round rods spaced 12 in. centers, horizontally and vertically. The reinforcement in the floor consisted of ½-in. rods, 5½-in. centers, transversely near the bottom of the slab between the spandrel walls. Every other rod was bent so as to be near the top in the outer part of the slab and continued up into the curbs at the sides. There were also 12 ¾-in. round rods placed longitudinally throughout the floor and wired to the transverse rods.

The deflections of the arch rings were observed at the following times: (1) Immediately after the erection of the four arch rings and before any concrete had been placed in them; (2) after the concrete had been filled in the arch rings to form the solid ribs; (3) after all the concrete had been placed in the spandrel walls and floor of the superstructure. The results are indicated in the following table:

Belvidere Bridge.

Table of elevations and deflections observed at intradas of arch ribs at crown. All elevations are 157′ + but only decimals of feet are given. Elevation at crown as per design, 157.46. Average actual elevation 157.47.

	Elevations, in ft.			Deflections in ft.		
	Before any concrete was placed.	After concrete was placed: In ribs and diaphragms.	After concrete was placed: In walls and floor.	Caused by load of concrete: In ribs and diaphragms.	Caused by load of concrete: In walls and floor.	Total deflection caused by dead load of structure.
Span No. 1:						
North rib	.43	.39	.37	.04	.02	.06
South rib	.38	.37	.34	.01	.03	.04
Span No. 2:						
North rib	.65	.56	.54	.09	.02	.11
South rib	.49	.41	.39	.08	.02	.10
Span No. 3:						
North rib	.63	.58	.55	.05	.03	.08
South rib	.60	.56	.53	.04	.03	.07
Span No. 4:						
North rib	.54	.53	.49	.01	.04	.05
South rib	.57	.56	.52	.01	.04	.05
Average	.54	.50	.47	.04	.03	.07

It will be noticed that the deflection caused by the filling of the concrete in the ribs is somewhat variable, which is probably due to the fact that the joints between the sectional forms may not all have been closed up completely. After the ribs had been completed the deflection caused by the additional weight of concrete in the spandrel walls and floor is very regular. The total deflection in no case exceeds the normal, and it is interesting to notice that the average elevation of the eight ribs at the intrados of the crown, after the completion of the structure, deviated only $^1/_{100}$ of a foot from what it was figured in the office

This design is the first practical application of this entirely new system of concrete bridge construction, and though it will be evident that the method is very unusual and that in working it out many new and untried conditions had to be met, yet the success of the system has been most pronounced. The great advantage of the construction is the elimination of centering, which is always a large portion of the total cost of a concrete bridge, and in deep and swift rivers makes construction not only extremely expensive but dangerous and risky. While for the sake of expediency in this case a traveler and temporary track were used for erecting the concrete-steel forms, the plan which will be followed hereafter will be the use of a cable way. In this way concrete bridges can be thrown across streams no matter what their nature, and after the foundations have been built there is no further danger or delay. It will also be evident that in this manner concrete bridges can be built across canyons and gorges of unlimited depth,

and over railroad tracks or highways without interfering with traffic.

The outfit required to construct these bridges involves a larger first cost, but after this outfit has once been acquired it enables the construction and erection of the sectional forms at very little cost and at remarkable speed. The steel moulds used at Belvidere will answer for a series of arches ranging in length from 25 ft. to 100 ft., and these forms can be used over and over again. Where there are a series of bridges to build at one time, as for instance on a railroad line, this feature attains great importance in reducing cost. Ribbed bridge construction in itself is undoubtedly the most economical as regards the quantities of material, and with the increased economy of erection made possible by this improved method of erection, the total saving as compared with other forms of concrete steel construction is, for the same factor of safety, about 30 per cent. It will be noticed that this method of construction is also applicable to buildings.

The Belvidere bridge was designed and built by the Strauss Bascule & Concrete Bridge Co., Chicago, which owns the patents of Mr. Strauss. The work was executed under the immediate supervision of Mr. K. Hojgaard, Engineer for the bridge company. The Elgin-Belvidere Railroad is under construction by the Arnold Company, Chicago, and this design of bridge was recommended to the company in preference to a steel structure, both for reasons of economy and permanence, by Mr. B. J. Arnold, President of the Arnold Company. Mr. George Weston was Engineer for the Arnold Company on the work.

How Best to Get Cars Through Large Terminals.*

System is the underlying principle of success in handling any large proposition, such as what we have to contend with at the head of the Lakes, and it must prevail, else failure or partial success will be the result. All who have been in the railroad service for any length of time will remember how insignificant car work was formerly considered. Car checkers and clerks were the cheapest men on the pay roll. The boys, the beginners, all were started with car work. Many times, during the rush of business, car reports were allowed to run for a week and I have known instances where car records were not touched for months during the busy season. These conditions existed during the time when handling the present volume of business was an unthought of possibility, and all railroads (except during the fall rush) had plenty of cars. Under the old mileage rules, cars were settled for on the basis of miles traveled. Foreign cars were settled for with lines interested, on the basis of miles traveled; therefore, if they remained on track or siding an unusual length of time there was no direct money loss to any one, providing cars had not been traveling loaded or empty through mistake or otherwise, the most serious complaint resulting in a mild reprimand from the superintendent.

Owing to the immense increase of the world's commerce, the most pronounced being that of our own country, every car building establishment in the United States has been running more than full time for the past few years, and even by so doing are unable to fill orders with any degree of promptness. This, with the increase resulting from many railroad companies building their own cars, should eventually overreach the everlasting increased demand for cars. I venture to say that if a dozen or more railroad officials were asked to-day where all the railroad equipment went to and their views on causes of shortage, you would have as many different opinions.

The handling and importance of all matters pertaining to cars has changed more completely in the last few years than any other branch of railroad service. Reports must be correct; must be made on time, often wired; yard and car clerks should no longer be cheap or inexperienced men, but should be the best, and car work should be kept up-to-date, regardless of how much help it takes. The yard office cannot be in possession of an over-supply of data. A sufficient number of yard clerks should be employed to make a daily check of the yards and other districts assigned to each individual yard clerk, so that when a car gets out of line (which is the case in all large yards where any number of switch crews are employed), he will immediately detect it and give such orders to yardmaster as will insure lining the car up for its proper destination. In this way it will not suffer to exceed a 24 hour delay at the outside. Otherwise, if the yard is not carefuly checked daily, such cars might lie around four or five days and not be looked up until complaint is filed by either consignee or shipper, which, of course, is embarrassing to traffic officials.

It might be well to mention demurrage in connection with delay to cars. Demurrage was never installed for money-making purposes, neither was it intended to work a hardship on the shipping public, and if handled judiciously is a direct benefit to shippers and railroad companies, from the fact that it expedites the loading and unloading of cars, making it possible for all to handle more tonnage. The former most bitter opponents of demurrage are now listed as champions and realize from the monthly reports at the head of the Lakes, that such a volume of business could not be handled without close checking and prompt movement.

As the delay to cars in large terminals may begin from the time of arrival, I will attempt to make my start from there also. Upon arrival of train at the terminal, way-bills covering loaded cars and slip bills covering empty cars should be turned over directly to the agent or yardmaster. If disposition of loads can be given, switch lists should be made to cover and loads switched accordingly. Such loads as cannot be disposed of at the time, or are necessarily delayed for inspection, weighing or other reasons, should be switched to tracks reserved for that purpose, to be disposed of from there later with all possible dispatch. If foreign cars are received in train for loading or other purposes, I would suggest the plan of marking such cars on black body of the door with red lumber crayon—which cannot be erased by rain or weather—showing date of arrival, road to which it belongs and foreign routing, via which line it may be handled. This serves a double purpose, that of giving switchmen information as to where he can apply it on any orders he may have, and also giving shipper necessary routing information for his loading. However, the card system is preferred and is more generally used. The above is for cars arriving.

The following system is suggested for cars forwarded or rather cars loaded at industries to be forwarded, or cars loaded for local or town delivery. Any cars loaded at industries on initial or connecting lines should not be handled or switched until switch bill is furnished by shipper and way-billing furnished to cover. In case this is not practicable, telephone instructions should be given to some designated central office and from there switch bill made to cover and information transmitted to switch foremen, as soon as possible as to how to handle, but in no case to allow switchmen to move cars until furnished, and the one in charge should have positive assurance that billing will follow. This will prevent cars being delayed for billing and saves additional switching. Loaded cars taken from industries or sidings should be delivered to connecting line, other local industries or switched into train order, the switchman having in his possession the switch list. Such cars as are owned by local roads would naturally go to them, unless otherwise specified. The foreign cars are all carded or chalked to show road they belong to. Work of putting into train order or placing at industries is of comparatively little note, but it is very important that holdouts be followed up closely and vigorously.

At the annual meeting at Minneapolis last year of the American Association of Local Freight Agents' Associations, a committee was appointed for the purpose of securing data and particulars of the switching systems in use throughout the country. The committee have classified various propositions as follows: Local orders or switch way-bills, the Indianapolis plan, the Burlington plan, the Keystone switch order system and the Southeastern plan. This committee was also instructed to give consideration to the question of switching charges, whether they should be made at certain rate per car or by the hundredweight, and reported that the preponderance of opinion as well as practice seems to favor a flat rate per car. While the report of this committee is of more interest to railroad auditors, it should also be interesting to railroads and the public, as it outlines the details of switching charges, as to how handled, etc.

In the switching and handling of cars at any terminal, the earnest co-operation of the public is necessary. They can assist the railroads as materially as the railroads can them, by giving disposition promptly, furnishing switch billing, etc.

*Presented at the June meeting of the Northern Railway Club by W. H. Smith, Asst. Genl. Agt., Northern Pacific Ry.

The South Canadian River Bridge of the K. C. M. & O. Ry.

The South Canadian river, in the vicinity of the crossing of the Kansas City, Mexico & Orient Ry., in Dewey County, Oklahoma, drains about 1,050 sq. m. and varies in width from 2,000 to 4,000 ft. The river bottom is mostly quicksand, from 12 to 60 ft. deep above the rock, which is a hard red sandstone. Within minor limits, the bridge location was selected at the point where the rock occurs closest to the surface. After a study of local conditions with respect to the elevation of high water, depth of foundations and the nature of the stream, 2,000 ft. was decided on as the necessary width of opening at the point of crossing, the north half of the bridge to be of steel on concrete piers, the south half to be of pile trestle, to be replaced later with a permanent structure.

The most economical class of structure for the steel portion of the bridge was found to be 50 ft. deck plate girders, and as this construction conformed to the necessary requirements in other respects, that type was adopted. The grade line was established to permit of replacing the pile trestle portion of the bridge with a steel structure of 70 and 85 ft. deck plate girders on cylinder piers. The whole structure was built by company forces and the construction of the piers, which are 1: 3: 5 concrete except the bridge seats.

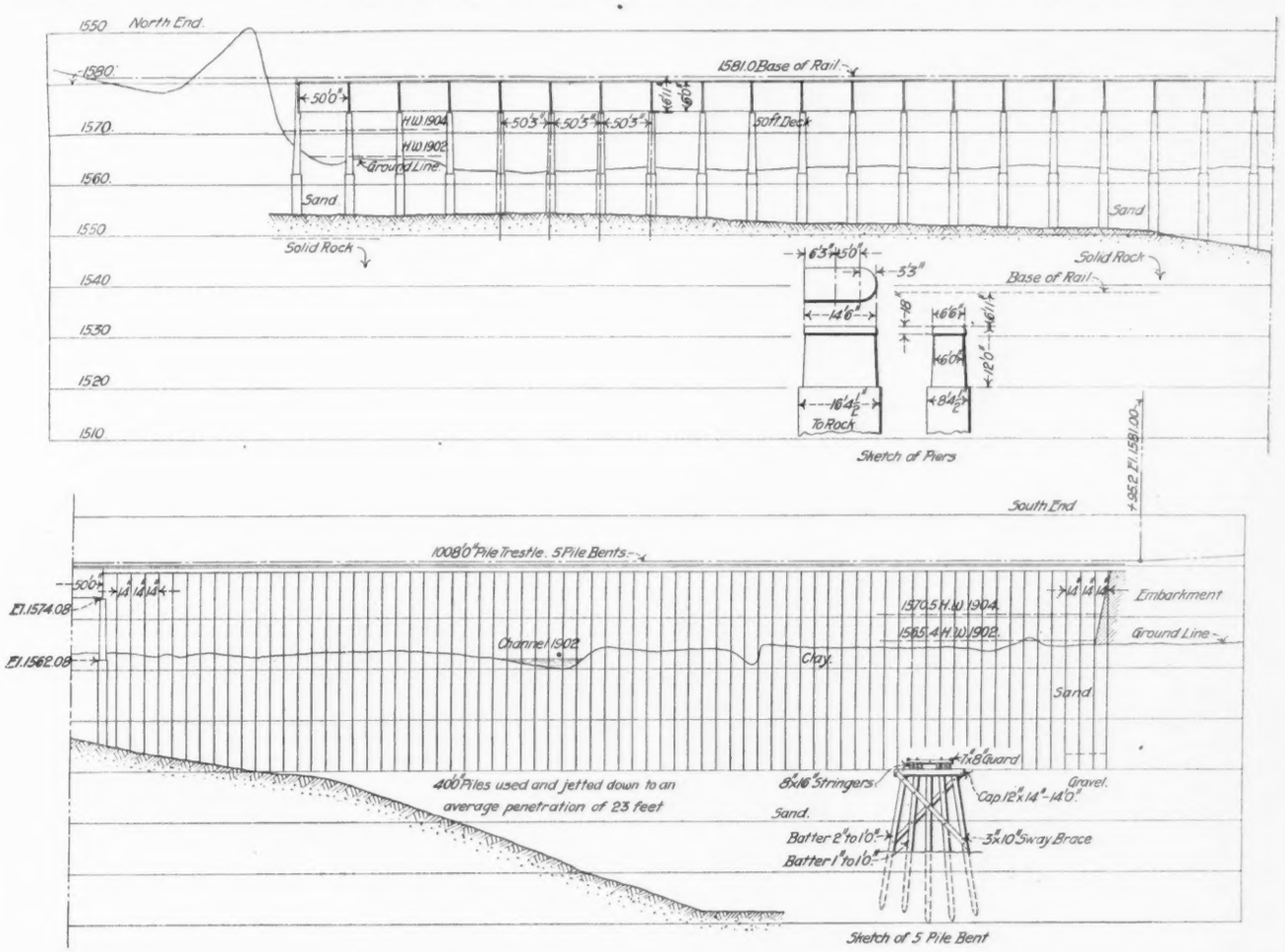
which are 1: 2: 4, was carried on as follows: The bases were put down in open cofferdams, the sheet piling for which was jetted to the rock. The sand was excavated by means of a centrifugal pump, and the bracing between the walls of the cofferdam placed in position as the excavation proceeded. After the cofferdam had been pumped dry, all leaks were caulked and the bottom of the sheet piles grouted with neat cement. In the lowest corner of the foundation a recess was formed to gather water from leakages, which was kept dry by means of a "Pulsometer" pump.

The concrete mixer and all other machinery was, as far as possible, located on the bank, above danger of damage by high water. A temporary track was laid, extending from the main line at the north end along the side of the embankment approach and out into the bed of the stream. The mixer and concrete materials were placed on the embankment between the temporary track and the main line and the concrete carried to the cofferdams in dump boxes set upon push cars. The chute from the mixer was placed to deposit directly into the dump boxes.

While the concrete was being deposited at one pier, the cofferdam for the first pier ahead was being excavated and the sheet piling of the second pier ahead was being driven. As the base of one pier was completed, the temporary track was extended to the next pier and supported on bents built of ties and jetted to the rock. In this manner work was carried on continuously on three piers. The grade of the temporary track was such that loaded cars were carried by gravity to the sites of the piers and were returned by teams.

After the completion of the bases, the forms for the shafts were set in place and the depositing of the concrete continued in the same manner as had been followed in the construction of the bases, with

South Canadian River Bridge of the K. C. M. & O. Ry.



Crossing of the South Canadian River, Kansas City, Mexico & Orient.

the exception that a derrick was placed at the pier and the concrete boxes lifted to the top of the form and dumped.

The cofferdams were originally designed with an inside form, to permit of removing the sheet piling after the completion of the base. This plan was found to be impracticable on account of the difficulty of preventing leaks and removing the sheet piling and was abandoned after the construction of the first two bases.

The cost of the concrete work, including cost of materials, labor, freight and all other expenses, was $8.80 per cubic yard.

The girders had been previously stacked in a convenient position and were set in place on the piers by means of a derrick car with a 40 ft. boom.

Work on the bridge was begun in October, 1905, and completed in May, 1906. We are indebted to Mr. M. P. Paret, Chief Engineer of the K. C., M. & O., for the foregoing information.

The Canal and the Railroad from 1861 to 1865.*

In the industrial development of the country from 1861 to 1865 no phase is more remarkable than the growth and prosperity of the canals and railroads. During four years of war there was a steady increase in traffic, unprecedented activity, and a surprisingly widespread public interest in transportation questions. At the close of the year 1861 the *American Railroad Journal* declared, "The year has on the whole been a very favorable one for the Northern railroads. Their earnings for the present season greatly exceeded those of 1860. Their traffics have immensely increased to supply the foreign demand for breadstuffs. It is consequently a somewhat remarkable fact that in a period of civil war the value of railroad property should have improved while that of all other kinds has greatly deteriorated." In the middle of the war, reviewing the year 1863, the same journal said, "The railroad system has greatly flourished the past year. The companies have got out of debt or largely diminished their indebtedness, their earnings are increasing, their dividends have become regular and inviting. The past year has been, therefore, the most prosperous ever known to American railroads."

Concrete illustrations of this growth are to be seen in the rapid increase in freight cars and in tonnage. The Pennsylvania Railroad, the Pittsburg, Fort Wayne & Chicago, the Erie, the New York Central, the Cleveland & Toledo, the Michigan Southern, the Chicago, Burlington & Quincy, the Illinois Central, and the Cleveland, Columbus & Cincinnati doubled their number of freight cars; those of the Central of New Jersey were more than trebled. The growth in freight carried was proportionate in almost every case. The movement of the enormous harvests was one cause of this unusual activity, especially to provide for exportation to Great Britain, where the harvests were poor in each of the successive years, 1860, 1861 and 1862. The stock market reflected this prosperity. Practically the first substantial sign of recovery from the crisis of 1861 was the heavy investment in railroad stocks in the summer of 1862, and from that time on, till the announcement in the fall of 1863 that the harvests in Great Britain were at last good, and that, therefore, there would be less activity in the movement of grain to the seaboard, these were the most prominent stocks on the Stock Exchange.

Of the various roads, those in New England, almost shut off from grain movement and army transport service, showed the least advance over their previous flourishing condition; those in Pennsylvania prospered with the growing output of iron, coal and petroleum which they carried; those in the West and Northwest, built in the previous decade far in advance of immediate needs, were now for the first time used to their utmost capacity in carrying the crops, which, but for them, could not easily have reached a market after the closing of the Mississippi; the North and South lines, such as the Illinois Central and the Cleveland, Columbus & Cincinnati, which had the previous record of never making money, throve on army business. The most prominent, if not the most important lines, were the three East and West trunk lines, the Pennsylvania, the Erie, and the New York Central, which were continued westward by the Pittsburg, Fort Wayne & Chicago, the Michigan Central, and the five lines later consolidated into the Lake Shore & Michigan Southern. Farther north the Grand Trunk reached the lakes in Canada, while to the south was the Baltimore & Ohio, largely within the war zone.

The various meat products sent eastward from Chicago commonly went over the railroads, especially the Pittsburg, Fort Wayne & Chicago, but in the middle of the war 99 per cent. of the wheat, 95 per cent. of the corn and 81 per cent. of the flour from Chicago took the lake route to Buffalo and other eastern lake ports, to be forwarded thence by rail and canal to New York and Boston. In 1862, 2,500 more vessels entered and cleared the port of Buffalo than in any previous year. Although the Erie and the New York Central had their own boats plying the lakes and supplying their steam lines at Buffalo and other lake terminal points, the Erie Canal took twice as much of this lake traffic as the two great railroads together. Never had the New York waterway performed such services. The boats on its waters rose from 3,000 in 1860 to 6,000 in 1863. The resulting activity in boat building was very great. Not since 1847, the year of heavy exportations of grain to famine-stricken Ireland, were so many vessels built on these canals of the Empire State as in 1862. In this year vessel building in every lake port also was greater than in any previous year. The commerce of the western rivers, where government transport service filled the gap made by the disappearance of the old southern trade, was comparable to that of the lakes. In the last part of the war more vessels were built on these rivers than for many years.

American transportation on the ocean had not so brilliant a record. Of the three American transatlantic lines started before the war, the Collins Line failed in 1858, the Bremen Line was withdrawn in 1858, and the Havre Line was taken into the government service. Flushed with pride over the success of their steam transportation on land, it was humiliating to Americans to see eleven foreign lines with 54 steamers entering their leading port, carrying the foreign mails, and meeting no American competition. The actual conditions of transportation on the ocean must be set over against those on the land in order to enable us to appreciate another phase of the general subject—the agitation for increased transportation facilities. Nothing is more characteristic of the period, aside from interest in war and politics, than the efforts of rival cities to gain commercial supremacy, to build additional means of transportation both on land and sea, and especially to improve connections with the West.

Of these cities, New York with the Hudson River Railroad, the New York Central, the Erie, the 11 transatlantic steamship lines, meeting on the best harbor of the continent, was easily the leader. Neither Philadelphia nor Boston had a line of steamers to Europe. The former had one trunk line leading to the West, but Boston was dependent on roads terminating in other cities. On the north Boston had a rival, small but growing—Portland, the terminus of the Grand Trunk. On the south, Philadelphia was opposed by Baltimore with the Baltimore & Ohio Railroad, but this border city was too harassed by war to be formidable while hostilities lasted. Every commercial city was the rival of every other, working for its own aggrandizement and the depreciation of all the rest.

New York's water communications with the West were quite as important as those by rail, and the attempts to improve them, while not so effective as the changes on the railroads, attracted much more attention both in the city and in the nation at large. The movement began in Chicago and the West in 1861, because there did not seem to be facilities to carry the crops of the year to market. The important route by the Mississippi River was closed, and consequently freight rates on other available lines became very high. The westerners insisted that these east and west lines, with their suddenly acquired monopoly, should be checked, and they called on the national government to open the Mississippi to the Northeast by enlarging the Illinois and Michigan Canal from the Great Lakes to the Illinois river.

At the same time the state of New York was aroused at the inadequacy of her accommodations for the western traffic, although after 27 years' work and an expenditure of $40,000,000 the state was just bringing to conclusion a great enlargement of the Erie Canal. If the increasing western crops were to be handled, the canal would have to be further enlarged. Again, the Trent affair brought into the discussion the military argument. However, the state was unwilling to tax itself a second time for the purpose. If the work was to be done, Congress might furnish money; but Congress held back. New York was plainly blocking Chicago, and Chicago was blocking New York.

Few anticipated the next step. Chicago business men held a mass meeting, and within less than six months transferred their local scheme into an almost national demand, with the hearty support not only of New York but also of many other parts of the Union. It was a fine illustration of the power of the western market over all sections. To bring New York to terms, Chicago held up to the public mind the rival route seaward of Canada and the St. Lawrence, setting forth the advantages of a route by way of Lake Michigan, Georgian Bay, a short canal connecting with the Ottawa river, and thence to the St. Lawrence and Europe, with a considerable saving of distance over the Erie Canal route.

Canada was in earnest; New York and New England were aroused. At the psychological moment in 1863, at a call signed by 14 United States Senators and 80 Representatives, a great ship canal convention assembled in Chicago; representatives from every section were present, strong eastern delegations coming from Portland, Boston and New York.

The final resolution by a mass vote was that the national government should be asked to improve both the Illinois and New York canals for military and commercial reasons. No action, however, was secured from Congress, for the opposition was very strong, particularly from Philadelphia, Pittsburg, Cincinnati and Milwaukee. Where railroads had not already superseded them, as, for example,

*From a paper by Emerson D. Fite, in the *Yale Review* for August, 1906.

in New York, nothing but state taxation of the land routes could keep the water routes alive. The relief must be immediate, while to complete the proposed improvements would require a long time. Chicago and New York, they declared, were using the cloak of military necessity to conceal their local and selfish designs, which it would be unwise for the general government to gratify, because so many other communities were clamorous for their special claims.

Despite this extended public discussion, little was practically accomplished for canals. No new ones were dug and no important improvements made. In railroad building, however, much was accomplished for New York and for all her rivals. The railroad interests were spurred to the greatest activity in their endeavor to hold their own against the popular canal agitation. Their most effectual response to the canal measures was the construction, by foreign capital, of a new trunk line to the West, the Atlantic & Great Western, built from Salamanca, New York, on the Erie Railroad, which furnished direct connection with New York City, to Dayton, Ohio, whence there were direct connections with Cincinnati over the Cincinnati, Hamilton & Dayton, and on to St. Louis over the Ohio & Mississippi. This was the greatest railroad achievement of the war. In May, 1865, when the first trains arrived in Cincinnati, shipments from New York, which had formerly taken 30 or 40 days, began to come through in less than a week. Merchants were delighted beyond expression. The daily press, realizing beforehand the significance of the road, faithfully chronicled the progress of the work as it advanced over the three states of New York, Pennsylvania and Ohio. A special excursion from New York, a banquet, speeches and fireworks celebrated the completion of the road to Cleveland, which had particular reasons to rejoice, for, besides through cars without change to New York, this city boasted that the Chicago and New York lake traffic, which now went by way of Buffalo, would be diverted to her to go eastward by the new road. There were similar celebrations in St. Louis and Cincinnati.

Philadelphia secured three new routes to the West. Since 1836 there had been a demand for a railroad northwest from Philadelphia to meet the lake route at Erie, but little was done till 1861, and during the excitement of the Presidential campaign of 1864 the road was completed. Erie with the new road, like Cleveland with the Atlantic & Great Western, would now contend with Buffalo for the honor of being the connecting link between the East and the West, and Philadelphia would wrest from New York some of that city's commercial prestige as the depot for western products. Governor Curtin, of Pennsylvania, left off making campaign speeches to join in a great excursion in honor of the event. Time was soon to prove how hollow were the hopes for the new line and how much more substantial were the results of connections secured in the West with Cincinnati and Chicago. In 1864 a new line was completed from Steubenville, Ohio, to Pittsburg, giving Philadelphia direct communications via Pittsburg with Columbus and Cincinnati, and with Chicago via existing lines from Columbus to Richmond, Ind., from which point a new road just completed led to Chicago. Thus in three ways Philadelphia met the competition of New York's new line, the Atlantic & Great Western.

New York on the north had another rival. Boston, the metropolis of New England, shut up in a corner away from the rest of the country, conscious that she had been comparatively indifferent in the past to the trade of the West, and that she was consequently losing her hold there, was aroused. Massachusetts had spent only $5,000,000 on western connections, and individuals of the state, together with the city of Albany, $11,000,000 more, while New York state had spent $65,000,000 for the same purpose, Pennsylvania and Philadelphia $40,000,000, Maryland and Baltimore $12,000,000, individuals in these states and cities $117,000,000, and Canada $75,000,000. Boston saw that she must exert herself to meet the occasion.

It was vexatious to Boston merchants to be dependent to so great an extent for their western trade upon a single line which was liable to be overcrowded, and which, without a rival save indirect routes through Canada, was able to extort high freight rates. All interests demanded a new western road, but while it was commonly agreed that it was impracticable to construct one through to the West, and that some existing trunk line should be tapped to divert traffic, there was no unanimity as to the manner in which this project should be realized. Negotiations to draw the terminus of the Grand Trunk from Portland to Boston were repeated each year, with no success, however, other than exciting much ill-will between the two cities.

South of the Grand Trunk were the New York Central and the Erie Canal, which might be tapped at Albany by a second line. As early as the completion of the Erie Canal in 1825, Boston men planned the Hoosac Tunnel and agitated for it. In 1848 the Troy & Greenfield Railroad was chartered and given seven years to build its road and the tunnel. There was delay in raising money and state aid was secured in 1854. In 1855 the tunnel was begun, but, although the company availed themselves of state aid again in 1860, little was done, and in 1861 they abandoned their task. In 1863 the state took up the unfinished work, and pushed it vigorously throughout the remainder of the war with Boston's hearty support. This was one of the most substantial public works of the period, rivaling the Atlantic & Great Western Railroad in general interest, and comparable to the great contemporary undertaking of tunneling Mt. Cenis in Italy.

Farther south than the New York Central was one of the eastern termini of the Erie Railroad at Newburg, N. Y., opposite Fishkill, to which point Boston capitalists in 1863 secured a charter for a road, designing to use some small existing roads, and to build the necessary connecting links. This line was to be called the Boston, Hartford & Erie, and all predicted for it a great future because it would bring direct connections, without change of cars, with Cincinnati and St. Louis; and further because it would have the advantage of delivering its freight by the side of the ships themselves, whereas the Boston & Worcester delivered its grain at its terminus on the Charles river, whence cartage was necessary across the city to the ocean. Despite all the agitation, however, the road was not completed till 1881.

In addition to trunk lines, another facility was needed before Boston could hope to become a great railroad terminus. Boston, in common with Philadelphia and in strange contrast to New York, had no regular steamship lines to Europe. If the competition with New York for western grain was to become serious, this lack must be supplied. It would avail little to build roads to bring more grain, if there were no swift steamers to carry it to its destination. Throughout the war both Boston and Philadelphia strongly and continuously agitated in favor of new transatlantic steamship companies. In Boston nothing was accomplished, but in Philadelphia in 1865, in imitation of the progressive Baltimore & Ohio Railroad at Baltimore, which had just inaugurated a steamship line of its own to Liverpool, the Pennsylvania Railroad in conjunction with the city of Philadelphia matured plans for a similar line.

Pittsburg, Cincinnati, St. Louis and Chicago were active equally with the seaboard cities in struggling for more trade. Pittsburg shared with Philadelphia in the benefits of the new connections with Columbus, Cincinnati and Chicago, already mentioned. She endeavored without success to reach the Baltimore & Ohio, but her strongest desire was to reach the newly opened oil fields in northwestern Pennsylvania. The Allegheny river was one avenue of approach to these. Another and more important one was the Erie & Pittsburg Railroad, projected before the petroleum discoveries but not completed till 1864. These two routes brought most of the crude oil to Pittsburg, and made her the great oil center. But there were rival routes, namely, two branches of the new Atlantic & Great Western, and a branch of the new Philadelphia & Erie, which transported some oil to New York and Philadelphia. Pipe lines were not invented till the very end of the war, and for the greater part of our period the oil had to be hauled to the steam cars in wagons over difficult country roads.

Cincinnati and St. Louis rejoiced in the completion of the Atlantic & Great Western, but aside from this east and west line the interests of the two cities in increased transportation lay in different directions; Cincinnati turned to the south, St. Louis to the west. The prize in the west for St. Louis was the large overland transportation business of the Missouri river towns with New Mexico, Pike's Peak and the Colorado gold mines, Utah, Nevada, and points on the plains. In 1860 it was estimated that from Kansas City, Leavenworth, Atchison, St. Joseph, Nebraska City and Omaha, approximately 7,000 prairie schooners were engaged in this trade, carrying over 36,000,000 lbs. of freight. During the war the trade increased. In 1865 21,000,000 lbs. of freight were despatched from Atchison alone, compared with 6,000,000 lbs. in 1860. The problem was to win this great market for St. Louis, and to keep it away from Chicago. The Pacific Railroad of Missouri was the solution. This road, planned as early as 1850 but completed only in 1865 after active work in the last part of the war, was the shortest route between these two cities, and, as it was enabled to reach farther and farther west over Kansas by the gradual completion of the Kansas branch of the Union Pacific, its value to St. Louis increased. It was prepared also to join the Atchison, Topeka & Santa Fe, whenever that much discussed road, now richly endowed by large land grants from Congress, should begin to traverse directly the old southwestern route.

Chicago's efforts to increase her trade were many and diverse. She worked toward the overland Kansas trade and the Kansas branch of the Union Pacific by gaining control of the Hannibal & St. Joseph Railroad. Her hold on the Nebraska branch of Union Pacific she made stronger by the consolidation of the Chicago & North-Western with the Galena & Chicago Union, thus securing a continuous line extending through Iowa 204 miles west of the Mississippi river, beyond which the construction of 130 miles of track would give through connections with Omaha, the Nebraska terminus of the Pacific road. She matured plans for new connections with St. Paul and the Northwest, she laid a new route to Madison, Wis., and, as she thought, gained complete control of the traffic from the iron and copper mines of northern Michigan by extensions of the Chicago & North-Western. Her three trunk lines to the East

she added to by building the Chicago & Great Eastern already mentioned, and at the very end of the war definite plans were laid for the extension to Chicago of the Grand Trunk from Port Huron, opposite Sarnia, Ontario.

The Pacific Railroad, to which the West, and, in fact, the whole country were turning, was the realization of public discussion as old as the discovery of gold in California. In 1853 Congress ordered the survey of northern, central and southern routes to the Pacific. By an act of 1862, amended slightly in 1864, the national government incorporated a company to build a road from the wilds of western Nebraska to the western border of Nevada, with a western branch leading to Sacramento; and in the east two branches, one leading through Nebraska to Omaha, the other through Kansas to Kansas City. The route was located by the existence of frontier settlements in Nebraska and Kansas, and by the thin strip of settlements extending across the continent through Colorado, Utah and Nevada. The government pledged itself to subsidize the line with 35,000,000 acres of public land and $50,000,000 in United States bonds. The incorporators in 1862 easily secured the necessary public subscriptions of $2,000,000, and at once many arguments in favor of the work were widely advanced. California must be drawn more closely to the Union, her trade retained and her secession made impossible; the nation's influence in the Pacific and its share in the commerce of the East must be advanced; the movements of the French and English in Mexico and Central America for short Isthmian railroads and canals must be checkmated. Western mining and agriculture must be fostered; great public works like this one and the Hoosac Tunnel must be pushed for the sake of their encouraging influence on the public mind. Only a few miles of track were completed while the war lasted, but that little aroused great interest. The laying of the first rails in Kansas, Nebraska and California was the occasion of much ceremony and public enthusiasm. After the war it was asserted that no public work since the Erie Canal had so held the public mind. The Northern Pacific, to which attention was directed by the discovery of gold in Idaho in 1863, was chartered in 1864, the government guaranteeing a subsidy in land of 47,000,000 acres, but no bonds.

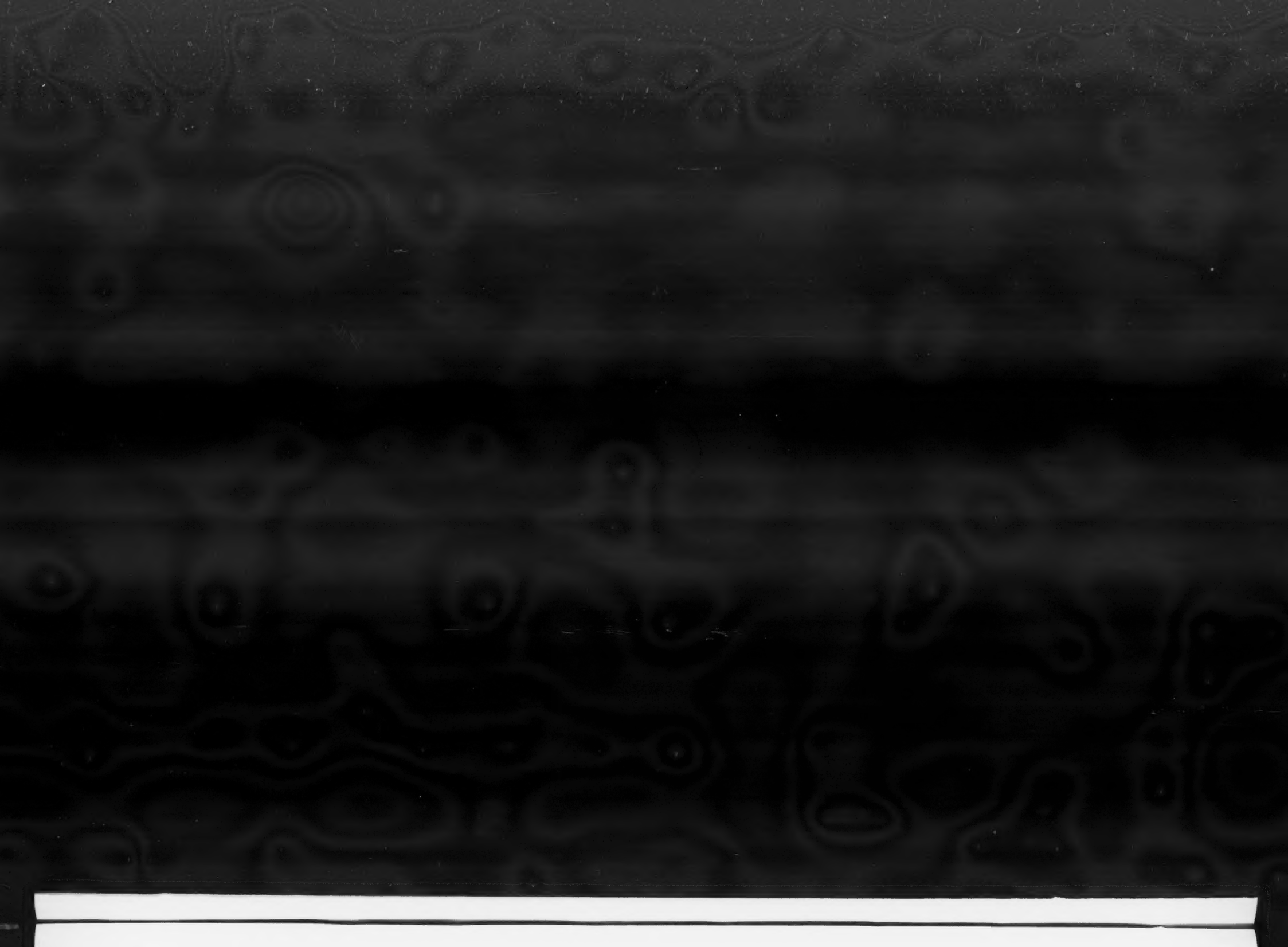
The most characteristic and important feature of transportation during the war, the one that accomplished most toward solving practical transportation problems, yet remains to be discussed—the gradual improvement of the facilities of the existing roads. The consolidation of small roads into larger ones was widespread. Boston's most effective stroke in achieving a new western route was her consolidation of the seven lines leading from that city to Ogdensburg, N. Y., in the hope that thereby she might tap the Grand Trunk across the St. Lawrence at that point; and her most earnest endeavor each year of the war toward bettering herself was to unite the Boston & Worcester with the Western Railroad, which continued the route to Albany. These two roads, composing her only direct route to the West, could not perform their best services while continually quarreling with one another over profits. But, despite the fact that their union was so important and public sentiment in favor of the union so strong, the consolidation was not effected till 1867. The Erie gained control of certain small lines in northwestern New York and changed its western terminus from Dunkirk to Buffalo. The Pennsylvania took over the Philadelphia & Erie, the Oil Creek Road, both leading to the oil fields, the Pittsburg, Fort Wayne & Chicago, and the Cleveland & Pittsburg. The four lines forming the Lake Shore route from Buffalo to Toledo, partly under the extending influence of the New York Central, united and eventually included in the agreement the Cleveland, Columbus and Cincinnati. In Canada the Grand Trunk and the Great Western were united. Examples could be multiplied, but sufficient have been given to show the universality of the tendency of small railroads to merge into large corporations. The phenomenon was not new, but nevertheless was now especially marked. Heavy traffic and the appreciation of gold could hardly have acted otherwise. It was in every way desirable to do away with the losses of competition between rival cities and between rival railroads, and in the presence of high prices to hold in check the expenses of management. Akin to this movement and as extensive was the reorganization of many roads and their establishment on firm financial ground, notably the old New York and Erie, the Pittsburg, Fort Wayne & Chicago, and the Chicago & North-Western.

An obstacle to all traffic was the different gages on the railroads in different parts of the country. On the New York and New England roads the rails were 4 ft 8½ in. apart; in Ohio, the West, and south of Philadelphia, 4 ft. 8½ in. and 4 ft. 10 in.;* in Canada and in some parts of Maine, 5 ft. 6 in., and in some special cases in the West 6 ft. In no direction could cars run long distances without changes and delays. The Hudson River & New York Central cars passed from New York to Buffalo without change, but could not run to Chicago over the Lake Shore route without changes on the five lines west from Buffalo; they could not go through Canada and strike the Michigan Central without similar changes, and if they proceeded over the Ohio roads to Cincinnati there was a change; the Pennsylvania could not send its cars west from Pittsburg without changes; there were changes between New York and Washington; Grand Trunk trains, suited to the Canadian gage, could not reach Boston from Portland, nor Chicago from Detroit, without the delay. In the opening of the war, when government officials made requisitions on the roads for cars, the response could not be immediate, and after the cars were once delivered there was the delay of fitting them to the southern tracks. In many cases there was no possible adjustment and the contents of trains had to be transferred to other cars. But although no standard gage was adopted, there was progress in doing away with the evil. The Atlantic & Great Western established a uniform broad gage from New York to St. Louis, an unusually long distance for one gage. The completion of the new road between Steubenville and Pittsburg made another uniform gage between two such distant points as Philadelphia and Cincinnati. The gage of the Oil Creek Road was made similar to that of the Pennsylvania. The Atlantic & Great Western entered Cleveland from Leavittsburgh by a third rail on the Cleveland & Mahoning, and Cincinnati in the same way over the Cincinnati, Hamilton & Dayton. Some roads, like the Pennsylvania for a part of its western traffic, availed themselves of a new patent wheel, extra wide, designed to accommodate different gages, while others, like the New York Central in its eagerness to reach Cincinnati, built cars of an adjustable axle, cars of a "compromise gage." The Star Freight Line between Buffalo and Chicago also used this latter expedient. There were few roads which did not have to deal in some way with this universal evil. It is not, then, surprising that the railroad traffic on the Lake Shore route between Chicago and Buffalo was so much lighter than that on the Pittsburg, Fort Wayne & Chicago, and on the lake steamers. Private and state initiative in railroad building was a good thing, but national supervision would never have allowed anything but a uniform gage.

Another obstacle quite as vexing as the existence of different gages was the absence of bridges over the wide rivers; "the chief miseries of traveling are changing cars and crossing ferries," said the *New York Tribune* of Aug. 11, 1861. But desirable as were improvements in this direction, and anxious as the railroads were to make them, there was strong opposition from the established ferry companies and from rival commercial cities. Troy endeavored to divert to her own bridge, away from the Albany ferry, all New York Central lines, and with injunction fought the forthcoming bridge at Albany in the courts, uselessly, however, for the great iron structure at the latter point was begun in 1864 and finished in 1866. It was a revolution in American railroading, attracting universal interest. The ferry companies successfully blocked all Mississippi river bridge projects at St. Louis, although there was an old charter for such a bridge, and the whole city united in fighting a new bridge over the river farther north which would be to the advantage of Chicago. Chicago won and the bridge, the second over the Mississippi, was built in 1864 by the Chicago & North-Western Railroad at Clinton, Iowa. A suspension bridge over the Ohio at Cincinnati was begun in 1864. The same river was bridged at Steubenville, thus connecting Pittsburg and Philadelphia with Columbus. A new bridge was erected over the Monongahela at Pittsburg. The ferry at Havre de Grace, Md., over the Susquehanna on the main route from Philadelphia to Washington was displaced.

In laying double tracks little progress was made before 1861, but during the war some of the leading lines advanced in this respect. The Hudson River completed double tracks from New York to Albany; the New York Central from Albany to Buffalo. The same was accomplished between New York and Washington. The building of new grain elevators was extensive. St. Louis had none at all, and to judge from the public discussion in her newspapers one would conclude that to erect a grain elevator was the most important step which that city could take in fighting the overshadowing and ever-growing predominance of Chicago. Without suitable storage facilities the one city could not hope to attract grain trade away from the other, equipped with a score of elevators. Detroit and Erie likewise got their first elevators. New York, which stored little grain but shipped vast amounts to Europe, in 1861, when the great grain exportations began, got her first floating elevators to lift the grain from lighters and canal boats to the steamers. Previously this work had been done, as in Boston, Philadelphia and Baltimore, by hand pulleys, an immemorial custom. The Irish laborers, by a stubborn strike and threats, most strenuously resisted the change, but the companies persisted. In the first year of the war two of the monster labor-saving machines were set up, five in 1862, the year of the strike, seven of them throwing 2,000 laborers out of work. Each year thereafter more were erected, as also in the other great cities of the seaboard, but, in spite of this fact, at the close of the war some of the grain was still handled in the old way in all these cities. Chicago and Buffalo were the great centers of grain elevators. Nothing better illustrates the growth of lake commerce in grain than the erection in Buffalo of nine new elevators during the war, doubling the capacity of the elevators of that city in four years.

*Also, 3 ft. 6 in.—Editor.



GENERAL NEWS SECTION

NOTES.

The Western & Atlantic has put the block system in use between Atlanta and Cartersville, 48 miles, and the Hocking Valley has put it in use on 35 miles.

According to a press despatch the Atchison, Topeka & Santa Fe has received more than $10,000 in cash from persons to whom it gave free rides out of San Francisco after the earthquake and fire of April 18.

The officers of the New York Central and of the New Haven road are now speaking of Oct. 31 as the date when some of the electric locomotives will be put in service on passenger trains to and from New York City.

The National Refining Co., and other independent oil companies of Indiana, have sent to the Railroad Commission of that state a complaint against 41 railroad companies for discriminating in favor of the Standard Oil Co.

According to a western paper the city officials of West Burlington, Iowa, all intend to resign their offices; this because they are railroad employees and, under a new law, are forbidden, as public officers, to ride on passes.

The Armour Car Lines have announced that they are no longer common carriers and will refrain from quoting or publishing rates for refrigeration, leaving the whole matter of dealing with shippers to be attended to by the railroads.

On request of the State Railroad Commission of Ohio the Interstate Commerce Commission has decided that any road desiring to change interstate fares to make them conform to the Ohio two-cents-a-mile law may do so on Oct. 1 by filing notice three days in advance.

A press despatch from Philadelphia says that the Pennsylvania Railroad, after conferences with delegates representing its telegraph operators, has increased the wages of its employees in that department to an extent involving the additional expenditure yearly of $70,000.

The Houston & Texas Central, acting on the advice of its legal department, has decided that whenever the air brakes of a train become defective between terminals, the train may lawfully proceed to the nearest terminal without air-brake power and depending on the hand brakes.

A Texas paper reports that the St. Louis & San Francisco has adopted the standard solid bridge floor of the Southern Pacific and has built four of such floors. These floors are made of plank and covered with ballast, so that the track lies in the ballast the same as on other portions of the roadway.

John O. Backus, of Mattoon, Ill., Assistant Superintendent of the Central Illinois Traction Co., killed himself with a pistol on Friday last, in consequence, it is said, of the verdict of a coroner's jury fixing on him the blame for a collision of cars on his road September 5, when the motorman was killed and several passengers were injured.

J. E. Walker, of Media, Pa., has complained to the Interstate Commerce Commission that the Baltimore & Ohio Railroad Co., acting in the interest of the United States Express Co., is refusing parcel express privileges to citizens of Media who ride on the electric street cars in preference to the trains of the B. & O. In consequence the complainants are compelled to have their express matter from Philadelphia sent over the Pennsylvania Railroad to a station five miles distant.

According to the *Sentinel*, of Knoxville, Tenn., the resignation of two train despatchers, of the Southern Railway, in that city, has disclosed a scarcity of competent men to fill such places. It is said that there is also much difficulty in securing competent telegraph operators, and this not only on the Southern Railway, but on the Baltimore & Ohio, the Pennsylvania and the Cleveland, Cincinnati, Chicago & St. Louis. On some of these roads there is also difficulty in securing enough competent trainmen in the freight service.

According to a Toronto correspondent, the Grand Trunk Pacific in ordering recently 50,000 tons of rails in the United States confidently expected that, owing to the national character of their enterprise, the import duty of seven dollars a ton would be remitted by the government; but this was refused, and on September 6th the company paid the duty on the whole lot, $382,000. The Dominion Iron & Steel Co. made a bid for the rail contract, and its failure to secure it is said to have been due to some disagreement between the road and the steel company over some matter of the past.

The Receivers' & Shippers' Association Co., of Cincinnati, E. E. Williamson, Commissioner, has asked the Interstate Commerce Commission to enforce that part of Section 20 of the amended Interstate Commerce law which requires the initial carrier to accept responsibility for loss of or damage to freight anywhere between the point of shipment and the destination. The complainant holds that this requirement of the law not only prohibits a carrier from contracting to be relieved of responsibility but also forbids exemption of the carrier from any loss and, therefore, forbids the contract, now universal in bills of lading, limiting the liability of the carrier. The Official, the Western and the Southern classifications still contain the stipulation whereby a shipper who will not assume certain liabilities must pay 20 per cent. above the published tariff rate. The existence of the present tariffs, containing this condition, is regarded as sufficient evidence, and the complainant therefore offers no testimony in support of its complaint.

Reductions in Fares.

The action of the Pennsylvania in reducing fares has led to numerous other reductions. At Cleveland, it is announced that the Baltimore & Ohio is to make interstate rates to and from points in Ohio on the basis of two cents a mile within that state, the present rate beng still used for parts of these journeys which lie in other states. The Erie announces that beginning Nov. 1, two-and-a-half cents a mile will be the maximum rate for local one-way tickets throughout its lines. West of Hornell, N. Y., and also for through passage between New York or Newark, and points west of Olean, 1,000-mile tickets, sold at a flat rate of $20 each, will be accepted. The Erie's interchangeable mileage book now sold at $30, with a rebate of $10, will be sold at $25 with a rebate of $5. The Lackawanna has issued a notice substantially the same as the Erie's. The interchangeable mileage book sold by the Reading, the Central of New Jersey, the New York Central, and the Buffalo, Rochester & Pittsburg, and good on all these roads, is now good for an unlimited time, and the price is $20 flat. This ticket, like the $20 tickets of the Erie and the Pennsylvania, is good for bearer. The Boston & Maine, heretofore selling a 1,000-mile ticket good only in Massachusetts, now sells a 500-mile ticket at $10, valid throughout the company's lines, and good for bearer.

New Bids for Arthur's Pass Tunnel.

New bids are wanted at the office of the High Commissioner for New Zealand, Westminster Chambers, 13 Victoria street, London, S. W., March 18, 1907, for piercing a tunnel five miles long at Arthur's Pass, through the range between Canterbury and Westland, on the line of the New Zealand Midland Railway, as noted on advertising page 22.

New Ferry Boat for the Long Island Road.

The new double-deck twin-screw propellor "Babylon" for the Long Island ferry service on the East river, New York, has just come out of the Harlan & Hollingsworth yards, Wilmington. The new steamer has a passenger capacity of 3,000, is 203 feet long and 65 feet wide. She is fitted with two fore and two aft engines, with cylinders 18 inches and 38 inches, with 28-inch stroke. The hull of the steamer, also the center house and outboard side and ceiling, horse gangway and inboard side of ceiling are all of steel. The vessel has 20 water-tight compartments, and is practically unsinkable.

Some Good Office Rules.

From a placard which is posted in the local offices of the National Express Company—in that part outside of the railing and devoted to the public—we copy the following rules. The whole placard, containing 18 rules, is of interest, as being a good example of intelligent rules, but the rest of them are more commonplace.

A "NOTICE TO THE PUBLIC," at the bottom of the card, says that "any lack of attention or of courtesy on the part of employees should be reported at once in writing to the General Agent."

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6. All business of the day must be completed each day, so that one day's work will not encroach upon the next. Before leaving his desk for the day, each clerk will see that his books and papers are properly arranged and put in their places. A place will be provided for everything, and it is expected that everything will be kept in its place.

9. *The most polite and gentlemanly treatment of all customers* —whether men, women or children, rich or poor, white or black, or however insignificant their business—*is insisted upon.* It must not be forgotten that the company is dependent on these same people for its business. These rules must be observed by employees in their communications and dealings with the public *over the telephone.*

10. Should customers call during the temporary absence of a particular clerk or after business hours of the day, whatever

clerk may be in the office at the time, of whom inquiries or requests may be made, will consider it his business, for the time being, to attend to the same; or if that cannot be done until the absent clerk returns, will explain the matter to customers in such a manner as to avoid any dissatisfaction.

15. Lounging about the office on Sundays will not be permitted. Employees will only be required to labor on that day when the necessities of the business demand. It is intended that the office shall remain closed and quiet as far as practicable on Sundays; and for the credit of the office, *as well as for their own benefit*, it is suggested that all employees attend church during the day.

Railroad Matters in Pekin.

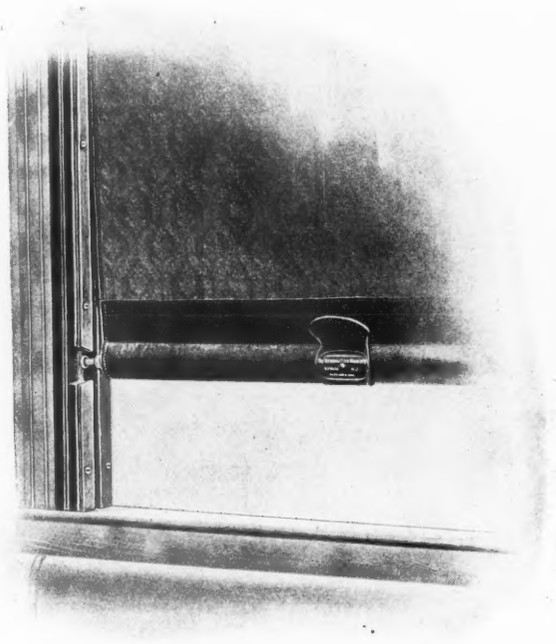
The Chinese government has failed to fulfil its promise to provide funds for the completion of the Shanghai-Nanking Railway. Tang Shao-yi has since informed the British Legation that an edict in reply to his memorial for the provision of funds will probably be issued within three weeks. This policy of constant disregard of promises is difficult to understand. It was also difficult to understand why China should authorize the construction under an imperial guarantee of railway joining the three great centers of population—Shanghai, Su-chau and Nanking—and then permit the officials like the corrupt Sheng or the conservative Viceroy Chau-fu to prevent the railway from coming nearer than five miles to Nanking city wall or nearer than four miles to the business quarter of Su-chau.

The negotiations for the Kau-lung-Canton railways were opened yesterday. The 90-mile railway from the mines to the waterway is not earning running expenses, and the guarantors, the Pekin Syndicate, are compelled to pay 1,500 taels (about $1,100) a month for losses in working, in addition to the £35,000 per annum guarantee. The Pekin Syndicate, however, hopes that if the water difficulties can be overcome prospects will improve. Meanwhile the syndicate has arranged to purchase 15,000 tons of coal from the native coal mines in the vicinity of the syndicate's mines and to transport the coal by junk to Tientsin for sale during the coming winter.—Pekin Letter, Aug. 24, in *London Times*.

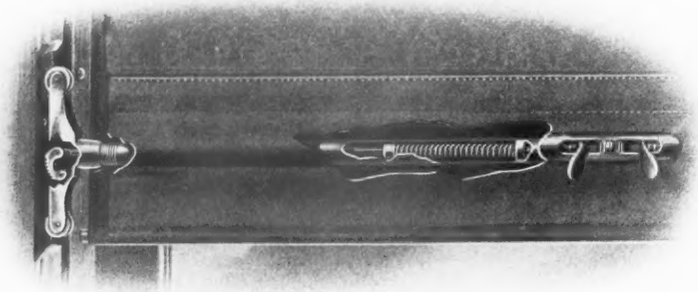
National Curtain Fixtures.

The accompanying illustrations show some details of the National cam curtain fixtures and the National balance curtain fixtures with protected groove, made by the National Lock Washer Co., Newark, N. J. The National cam curtain fixture automatically locks against the tension of the spring roller by means of spring pursed cams pivoted in the heads of the guides at each end of the fixture and bearing against the bottom of the grooves as shown. The heads are stationary on the bar and thus cannot be drawn out of the grooves when the finger pieces are compressed. Strong tension is put on the spring roller at the top, and as the fixture automatically locks at the bottom against all upward pull the strain all comes on the curtain, causing it to set perfectly smooth. The strong tension also insures quick action when the curtain is raised and holds the curtain firmly when the wind is blowing.

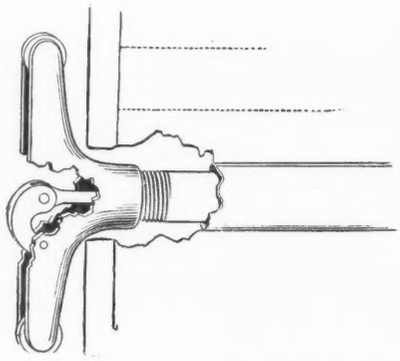
Each head is provided with two non-friction rollers, thus producing a perfectly smooth running curtain. The locking cams, which are pivoted eccentrically, are self-adjusting to variations of woodwork, varnish or paint. The fixtures are adjustable ½ in. by means of the heads which are screwed in. This is ample to allow for any variations in the woodwork in the window frames. Smooth face cams are furnished, instead of the toothed cams, to those desiring a curtain that may be pushed up without compressing the finger pieces. The National balance curtain fixture with protected groove is especially designed for open cars. This curtain requires no cable and the pinch handles are also eliminated. The mechanism is very simple, as shown in the accompanying illustration; all parts are protected, therefore there are no chances for anything to get out of order. The weight of the steel rod at he bottom of the curtain balances just evenly with the tension of the roller. The springs in the rod press the heads against the bottom of the grooves with enough friction to hold the curtain at any point desired up or down the length of the runways. An excellent feature is the storm lock at the bottom of the run to lock the curtain, which can be released by an extra strong pull.



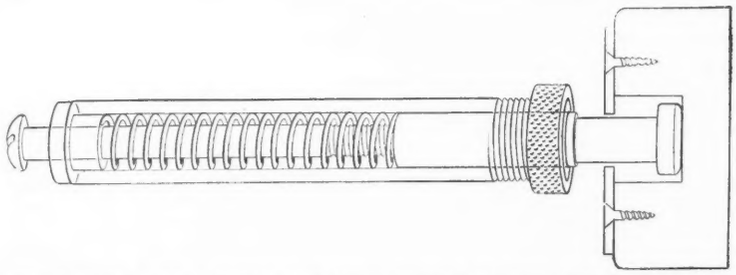
National Balance Curtain Fixture.



The National Cam Curtain Fixture.



Smooth Cam for National Cam Curtain Fixture.



Construction of the National Balance Curtain Fixture, with Protected Groove.

Manufacturing and Business.

Paul Dickinson, Chicago, head of the railroad supply house bearing his name, died at his home in Winnetka, Ill., August 31, of anæmia. He had been ill for some months but until recently was still able to give attention to his business affairs. Mr. Dickinson was best known in connection with his work on engine house ventilation, and his house made a specialty of smoke jacks.

Iron and Steel.

The Havana Central of Cuba has bought 5,000 tons of rails from the Carnegie Steel Co.

Exports of 2,000 tons of rails have been made from Baltimore to Mexico, and 1,579 tons to the Argentine Republic.

For supplying 5,000 tons of rails to the Isthmian Canal Commission the U. S. Steel Products Export Co., of New York (United States Steel Corporation) bid $147,250, which is at the rate of $29.45 per ton delivered f.o.b. at Baltimore.

The Pennsylvania has given a contract to the Pennsylvania Steel Co. for 38,000 tons of rails, and the Missouri & Northern Arkansas has ordered 6,000 tons of standard rails from an eastern mill, the latter for 1907 delivery. The more important of the small orders are: Four thousand two hundred tons for the San Antonio & Aransas Pass, 2,000 tons for the Los Angeles Railway, 1,800 tons for the Seattle Electric, 1,500 tons for the Fairmont & Mansfield, 500 tons for the Braddock Heights & Jefferson Electric, and 1,300 tons for another electric line.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad conventions and engineering societies, see advertising page 24.)

Western Railway Club.

The first meeting of the ensuing club year will be held in the Auditorium Hotel, Chicago, Tuesday, September 18, at 8 o'clock p.m. A stereopticon lecture on "Boiler Explosions" will be delivered by Mr. Jas. L. Ford, Chief Inspector, Hartford Steam Boiler Inspection & Insurance Company.

ELECTIONS AND APPOINTMENTS.

Executive, Financial and Legal Officers.

Cincinnati, Hamilton & Dayton.—C. C. Koerner, Acting Auditor of Disbursements, has been appointed Auditor of Disbursements of this road and of the Pere Marquette.

Erie.—E. H. Harriman and W. P. Hamilton have been elected Directors of the New York, Susquehanna & Western, succeeding A. S. Hopkins and W. L. Bull, resigned.

Gulf & Interstate.—G. W. Barns, Treasurer, has been appointed Auditor, succeeding G. E. Deyo, resigned. E. M. Barns has been appointed Treasurer.

New York, Susquehanna & Western.—See Erie.

Pere Marquette.—See Cincinnati, Hamilton & Dayton.

Operating Officers.

Atlantic City Railroad.—O. E. Weidner, trainmaster at Camden, N. J., has been appointed Assistant Superintendent, with office at the same place.

Canadian Northern.—Gordon Campbell has been appointed Assistant to the General Superintendent. Charles Carey has been appointed Superintendent at Edmonton, Alb. James Abbott, Acting Superintendent at that point, has been appointed Assistant Superintendent, with office at Battleford, Sask.

Chicago Great Western.—Tracy Lyon, Assistant General Manager, has resigned to go to one of the Westinghouse companies.

Chicago Terminal Transfer.—C. E. Peterson has been appointed Car Accountant, succeeding J. E. McGary, resigned, to go into other business.

Cincinnati, Hamilton & Dayton.—G. H. Waldo has been appointed Superintendent of Car Service, with office at Cincinnati, Ohio, succeeding W. C. Andrews, resigned.

Columbus & Southern.—A. F. Brewer has been appointed Superintendent of Car Service.

Denver & Rio Grande.—E. W. Spencer has been appointed Superintendent of Car Service, with office at Denver, Colo., succeeding H. F. Parke, resigned.

Galveston, Harrisburg & San Antonio.—D. T. Forbes, Superintendent at Victoria, Tex., has resigned to go to the Colorado & Southern.

International & Great Northern.—The office of H. S. Carrington, Assistant Superintendent at San Antonio, Tex., has been removed to Taylor, Tex.

San Antonio & Aransas Pass.—F. C. Smith has been appointed Assistant General Manager, with office at San Antonio, Texas. R. H. Innes, Superintendent of Transportation, has resigned and this office has been abolished. F. L. Lewis, Assistant Superintendent of Transportation, has been appointed Superintendent, with office at Yoakum, Tex.

Seaboard Air Line.—The office of J. H. Witt, Superintendent of the Third division, has been removed from Atlanta, Ga., to Abbeville, S. C.

Trinity & Brazos Valley.—J. M. Lee has been appointed Superintendent, in charge of transportation and of the mechanical and maintenance of way departments, with office at Cleburne, Texas.

Traffic Officers.

Central of New Jersey.—W. C. Hope, Assistant General Passenger Agent, has been appointed General Passenger Agent, succeeding C. M. Burt, resigned to go to the Boston & Maine.

Chicago, St. Paul, Minneapolis & Omaha.—H. G. Pearce, General Freight Agent, has been appointed Freight Traffic Manager.

Illinois Central.—Joseph Hattendorf has been appointed Assistant General Freight Agent at Memphis, Tenn.

St. Louis, Rocky Mountain & Pacific.—W. A. Gorman has been appointed General Freight and Passenger Agent, with office at Raton, N. Mex.

Wisconsin Central.—C. E. Wilson, Assistant General Freight Agent, has resigned on account of ill health.

Purchasing Agents.

St. Louis & San Francisco.—W. E. Hudson, Acting Purchasing Agent, has been appointed Purchasing Agent.

Georgia Southern & Florida.—The office of Acting Purchasing Agent has been abolished and its duties are now performed by S. F. Parrott, Vice-President.

Engineering and Rolling Stock Officers.

Alaska Central.—W. B. Poland, Chief Engineer and Manager, has resigned.

Boston & Maine.—C. B. Smith, Master Mechanic at Boston, Mass., has been appointed Mechanical Engineer, with office in that city.

Buffalo & Susquehanna.—C. S. Mills has been appointed Master Mechanic at Galeton, Pa.

Oregon Short Line.—Henry Carrick has been appointed Master Mechanic at Pocatello, Idaho, succeeding W. J. Tollerton, resigned, to go to the Chicago, Rock Island & Pacific.

Pennsylvania Lines West.—F. M. Crowell, Assistant Engineer at Pittsburg, Pa., of the Southwest System, has been appointed Engineer of Maintenance of Way at Cambridge, Ohio, on the Northwest System, succeeding Guy Scott, transferred.

Quincy, Omaha & Kansas City.—A. M. Collins, Chief Engineer, has resigned on account of ill health. C. T. Brimson, Assistant Engineer, has been appointed Engineer of Maintenance of Way.

LOCOMOTIVE BUILDING.

The Isthmian Canal Commission opened bids recently for 40 locomotives, and the lowest bid came from the Baldwin Locomotive Works.

The Canadian Pacific, it is reported, has ordered 50 consolidation (2-8-0) type locomotives from the Montreal shops of the American Locomotive Co.

The New York, New Haven & Hartford has ordered 12 Atlantic (4-4-2) type and 30 Pacific (4-6-2) type locomotives for September, 1907, delivery. The Atlantic type locomotives will have cylinders 21 x 26 in., driving wheels 80 in. in diameter, and will weigh 180,000 lbs. The Pacific type locomotive will have cylinders 22 x 28 in., driving wheels 72 in. in diameter, and will weigh 220,000 lbs.

The Chicago, Burlington & Quincy, as reported in our issue of September 7th, has ordered 15 simple Pacific (4-6-2) type locomotives from the Baldwin Locomotive Works, and 50 simple Prairie (2-6-2) type locomotives from the American Locomotive Co. The diameter of the drivers of the Pacific type locomotives is 74 in. and of the Prairie type 69 in. Cylinders of all engines are 22 x 28 in.; working steam pressure, 210 lbs.; tank capacity, 8,000 gallons, and coal capacity, 15 tons.

CAR BUILDING.

The Pennsylvania, it is reported, is about to place an order for 14,000 additional freight cars.

The New York Central is asking bids on 9,000 box, 6,000 steel gondola, 2,000 steel hopper and 2,000 steel flat cars.

The Delaware & Hudson is reported in the market for 2,000 box, 500 hopper and 2,200 flat, produce and miscellaneous cars.

The Kanawha & West Virginia has ordered 60 gondola cars of 60,000 lbs. capacity from the Hicks Locomotive & Car Works.

The Nashville, Chattanooga & St. Louis has ordered four passenger and two combination passenger and baggage cars from the Pullman Co.

The Northern Pacific is in the market for 1,500 flat and 1,000 steel dump cars in addition to the 4,000 box cars ordered from the American Car & Foundry Co.

The Atlantic Coast Line has ordered from the Standard Steel Car Co., Butler, Pa., 500 steel underframe box cars and 500 steel underframe flat cars. Deliveries to begin in January, 1907.

The Chinese Government has ordered from the Wason Car Co., Springfield, Mass., five second class and 10 third class passenger coaches and two baggage cars for the Canton-Hankow Railroad, and is in the market for 25 more cars.

The Boston Elevated has ordered four flat cars of 60,000 lbs. capacity from the Hicks Locomotive & Car Works for October 19th delivery. The cars will be 40 ft. long over all, 36 ft. 6 in. inside measurement and 8 ft. 7 in. wide. They will be fitted with Hicks standard trucks and Van Dorn drawbars.

The Chicago, Indianapolis & Louisville has ordered two 75-ft. combination cars and two 60-ft. postal cars from the American Car & Foundry Co., for December and January delivery. The special equipment for both includes:

Brake beams	National-Hollow
Brakes	Westinghouse
Brasses	More-Jones
Couplers	National
Curtain fixtures	Curtain Supply Co.
Curtain material	Pantasote
Dust guards	Harrison
Heating system	Consolidated Car Heating Co.
Journal boxes	Symington
Light	Pintsch
Springs	Pittsburg Spring & Steel Co.
Vestibules	American Car & Foundry Co.
Wheels	Paige

The Harriman Lines, as reported in our issue of August 10, have ordered 4,050 box cars of 100,000 lbs. capacity for the Union Pacific, Oregon Short Line, Oregon Railroad & Navigation, Pacific System, Morgan's Louisiana & Texas, Louisiana Western and Cananea, Yaqui River & Pacific from the Pressed Steel Car Co., delivery to begin Jan. 15, 1907; 1,450 flat cars of 100,000 lbs. capacity for the Union Pacific, Pacific System, Louisiana Western, Morgan's Louisiana & Texas, and Cananea, Yaqui River & Pacific from the Standard Steel Car Co., for January, 1907, delivery; 625 tank cars of 12,500 gallons capacity for the Southern Pacific from the Pressed Steel Car Co., delivery to begin March, 1907; 600 hopper cars of 100,000 lbs. capacity for the Southern Pacific, Union Pacific and Oregon Short Line from the Cambria Steel Co., delivery to begin October, 1906; 500 gondola cars of 100,000 lbs. capacity from the Cambria Steel Co., delivery to begin October, 1906; 500 stock cars of 80,000 lbs. capacity from the Pressed Steel Car Co., delivery to begin Jan. 15, 1907, and 100 flat car bodies of 80,000 lbs. capacity from the Standard Steel Car Co. for the Oregon Short Line, and 350 convertible dump cars of 100,000 lbs. capacity for the Union Pacific, Oregon R. R. & Navigation, Galveston, Harrisburg & San Antonio, Morgan's Louisiana & Texas, and Cananea, Yaqui River & Pacific from the Rodger Ballast Car Co., for March, 1907, delivery. The box cars will weigh 40,439 lbs. and measure 40 ft. ⅛ in. long, 8 ft. 6½ in. wide and 8 ft. ¼ in. high, inside measurements. The flat cars will weigh 32,570 lbs. and measure 40 ft. 10 in. long, 9 ft. 4½ in. wide. The tank cars will weigh 46,650 lbs. and measure 41 ft. 10 in. long and 12 ft. 11⅛ in. high, over all. The hopper cars will be 30 ft. ¼ in. long, 9 ft. 6 in. wide and 5 ft. 9¼ in. high, inside measurements. The gondola cars will weigh 40,170 lbs. and measure 40 ft. 4 in. long, 9 ft. 4⅞ in. wide and 4 ft. 6 in. high, inside measurements. The stock cars will weigh 35,091 lbs. and measure 36 ft. 6⅛ in. long, 8 ft. 5⅜ in. wide and 8 ft. ¼ in. high, inside measurements. The dump cars will weigh 43,000 lbs. and measure 41 ft. 6 in. long and 7 ft. 11 in. high, over all. The special equipment for all includes:

Bolsters	Simplex
Brake beams	Damascus and Chicago Railway Equipment Co.
Brake shoes	American Brake Shoe & Foundry Co.
Brasses	Hewitt Mfg. Co.
Couplers	National Malleable Castings Co.
Door fastenings	National Malleable Castings Co.
Draft rigging	Miner
Dust guards	National Malleable Castings Co.
Journal boxes	National Malleable Castings Co.
Roofs	Standard Railway Equipment Co.
Springs	Railway Steel Spring Co.

RAILROAD STRUCTURES.

Baltimore, Md.—The Baltimore & Ohio has moved into its new office building, which is 14 stories high and has accommodation for 3,000 employees. This building was recently completed to replace the structure destroyed by fire.

Brandon, Man.—The Great Northern and Canadian Pacific are planning to jointly put up a union passenger station here.

Brooklyn, N. Y.—Bids were recently opened by the Dock Department for dredging and building the Brooklyn Terminal for the 39th street ferry. The lowest bidders were B. Rolf, who agreed to do the work for $253,333, the work to be finished in about 8 months.

Gadsden, Ala.—The Alabama Great Southern, it is reported, has let contracts for car works in this city to local builders. The ground has been graded and the work will be begun at once.

Lexington, Ky.—A contract has been let by the Queen & Crescent at $60,000 for putting up a union passenger station.

Little Rock, Ark.—A contract for putting up a new passenger station here has been let to Westinghouse, Church, Kerr & Co. The cost of the station will be about $400,000.

Meridian, Miss.—The new union passenger station recently completed has been opened for traffic.

New York, N. Y.—The New York, Westchester & Boston has let a contract for building its main power station at Eastchester, in the Borough of the Bronx. It is to cost $800,000. The company will also build six sub-stations in the Bronx and in Westchester County.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

Alaska Central.—This company, which is building a line from Seward, on Resurrection Bay, to the Tanana river, in the interior of Alaska, about 500 miles, has completed about 50 miles of the road. A great deal of heavy construction work, including 2,500 ft. of tunneling, has been done beyond the end of the track. W. B. Poland, who had charge of this work, has resigned. (June 29, p. 188.)

Anniston & Columbus.—Incorporated in Alabama to build a line from Anniston, Ala., southeast via Roanoke to Columbus, Ga., about 110 miles. The incorporators, most of whom are residents of Anniston, include James Sprauwell, T. A. Kilby, N. V. Melbourne and W. P. Acker. W. H. Wetherlee is President, and O. H. Parker, Secretary and Treasurer.

Atchison, Topeka & Santa Fe.—This company has bought the Arkansas Valley, which the American Beet Sugar Company began to construct from Rocky Ford, Colo., on the north shore of the Arkansas river, to Lamar, a distance of 65 miles. The line now is completed to Shelton, 8 miles from Rocky Ford. Grading is completed to Horse Creek, 17 miles farther on, and much work has been done to Lamar. The A., T. & S. F. main line reaches these places on the south side of the Arkansas river.

Atlanta, Griffin & Macon (Electric).—Incorporated in Georgia with $100,000 capital, by N. T. Pratt and E. P. Ainsley, of Atlanta; J. F. Moore, of Macon; N. B. Drury, of Griffin, and others, to build an electric line from Atlanta, Ga., southeast to Macon, about 90 miles.

Augusta & Louisville.—Incorporated in Georgia with $500,000 capital to build a line from Louisville, in Jefferson County, Georgia, east to a point on the Augusta & Florida, about eight miles. The office of the company is to be at Louisville and the incorporators include J. C. Stone, R. M. Murphee, M. D. Jones and A. W. Jones, of Midville, and R. J. Piele, of Vidette.

Baltimore & Ohio.—This company is now laying third and fourth tracks on its main line between Pittsburg, Pa., and McKeesport, 15 miles. Work is also in progress on the double tracking of the Metropolitan branch between Washington and Washington Junction, 12 miles of which is still single. Similar work is also being carried out at several places between Pittsburg and Chicago.

Canadian Northern.—An officer writes that this company is planning to extend its line along the east bank of Lake Manitoba north of Oak Point. The date for receiving bids for the work has not as yet been decided upon. The work will be easy. The line is to have light grades and easy curves.

Canadian Pacific.—A special meeting of the Board of Directors is to be held to authorize the following: A new road from Petersboro to Victoria Harbor, 96 miles, for a new and better route for grain to tide water; leases of the Joliette & Brandon, 13 miles; the Walkerton & Locknow, 37 miles, and the Berlin, Waterloo, Wel-

lesley & Lake Huron; construction of Moose Jaw branch, 50 miles; Wayburn branch, 36 miles; Stonewall branch extension, 20 miles; West Selkirk branch extension, 10 miles; Lauder branch, 20 miles, and Darlingford branch, six miles.

CANANEA, YAQUI RIVER & PACIFIC.—See Southern Pacific.

CARDENAS RAILROAD & TERMINAL CO.—An officer writes that this company, which was recently incorporated in New Jersey, has made application to the Cuban Government for permission to build railroads in the Island of Cuba. John S. Fiske, 27 William street, New York, is secretary. (Aug. 17, p. 38.)

CATAWBA VALLEY.—Contracts are reported let by a company under this name to build 10 miles from Salem, Va., to Catawba Valley. James Smith has a contract for 2 miles, and Hampton Johnson one for the remaining 8 miles.

CENTRAL OF GEORGIA.—Superintendent Pollard is quoted as saying that this road will soon begin the work of extending its lines from Albany, Ga., southwest through Baker County and to the extreme southwestern corner of the state. Five companies have petitioned the Secretary of State for charters for lines through this section, but it is probable that only one of the companies will build. Baker County is the only county in the state which is not touched by a railroad. Newton, the county seat, is 12 miles from Camilla, the nearest railroad station.

CHERRYVALE, OKLAHOMA & TEXAS.—At a recent meeting of the stockholders of this company, S. M. Porter, of Caney, was re-elected President. A proposition to build the road was accepted by W. R. Stubbs, of Lawrence, and it is probable that active work will be started by November 1. (Aug. 10, p. 38.)

CHICAGO & MILWAUKEE (ELECTRIC).—This company on September 1st began running trains on its new line from Evanston, Ill., north to Racine, Wis., 50 miles.

CHICAGO, MILWAUKEE & ST. PAUL.—Contracts are reported let by this company to H. C. Henry, of Seattle, for building its proposed line from Bitter Root Mountains, Idaho, west to the Columbia river. The route follows the Joseph river to a point below Ferrell, Idaho, thence to Tekoa, Wash., to Rosalia, along the south side of Rock Lake to Lind, on the Northern Pacific. From Lind the line will practically follow the survey of the old Northern Pacific cut-off from Lind to Ellensburg. Contracts for a part of the work have been let to Grant Smith & Co. Work is now under way near Rosalia, and it is to be completed by January, 1908.

CHICAGO NORTHWESTERN.—A contract has been let by this company to M. J. Peppard, of Minneapolis, for laying about 70 miles of new track in Wisconsin. The work includes a ten-mile extension east from the end of the Antigo branch. From the end of the new extension a line 30 miles long is to be run in a northerly direction, and one 30 miles to the south. It will take about one year to complete the work.

CITIZENS' RAILWAY & LIGHT CO.—Incorporated in Texas with $1,000,000 capital, by W. Bickwell, J. B. Nutt and E. W. Christy, of Cleveland, Ohio; W. O. Allen, of Fostoria, Ohio, and others, to build interurban lines radiating from Fort Worth, Tex.

DENVER TRANSCONTINENTAL.—Incorporation has been asked for at Denver, Colo., by this company, which proposes to build a line from Denver southwest to San Diego, Cal., on the Pacific coast, near the Mexican line. The company is to be capitalized at $20,000,000, and has filed applications for charters in Utah, Nevada and California. The incorporators are: Wm. A. L. Cooper, of Denver; R. E. Vidler, of Georgetown, and C. A. Baldwin, of Colorado Springs. It is said that the incorporators represent the Guggenheimers, the Chicago, Rock Island & Pacific, and a British syndicate.

GRAND TRUNK PACIFIC.—J. D. McArthur, who has a contract for building the section of this line from Winnipeg to Lake Superior Junction, has sublet 15 miles to W. T. Parsons, of Kenora, Ont. The work will be through solid rock, and will require the removal of approximately 1,000,000 cu. yds. of rock.

GREENWICH & JOHNSONVILLE.—This company is making surveys for an extension of its line from Greenwich, N. Y., northeast via Battenville and Centre Falls, to a connection with the Salem & Washington branch of the Delaware & Hudson at Rexleigh, N. Y., about 10 miles.

IDAHO, MONTANA & CALIFORNIA.—This company, it is said, will shortly begin grading its proposed line. The company has opened offices at Caldwell, Idaho, which place is to grant a bonus of $40,000. Secretary E. E. Springer is quoted as saying that the route has been surveyed and contracts will be let for the grading at once; it is expected to have the line completed to Winnemucca by the end of 1907. This is supposed to be a Hill project, as the Northern Pacific surveyors are reported at work upon the final survey from Snake river to Winnemucca.

INDIANAPOLIS WESTERN TRACTION.—This company began regular service on its new line September 1st from Denville, Ind., east to Indianapolis, 20 miles. The cars run to and from the Traction Terminal station in Indianapolis.

LAS VEGAS & TONOPAH.—An officer writes that this company, which is building from Las Vegas, Nev., on the San Pedro, Los Angeles & Salt Lake northwest to Tonopah, 215 miles, has completed the road from Las Vegas to Rose's Well, 100 miles. The route is via Corn Creek, Indian Springs and Amargosa (formerly Johnnie). Work is under way by Deal Bros. & Mendenhall on the construction of the line as far west as Rhyolite in the Bullfrog District. Maximum grades will be 1.5 per cent., and maximum curves 3 deg. 30 min. Contracts for extending the line from Rhyolite to Tonopah have not as yet been let. (Aug. 10, p. 39.)

LONG ISLAND.—The State Railroad Commissioners recommend that this company abolish six grade crossings along the line of its road. At Old Westbury Road in North Hempstead, and at New York avenue and Old Swamp Road in Huntington the crossings are to be carried over or under the road. The remaining four are to be discontinued; they are at Eastport, at Southampton, and two at Brookhaven. The original application to the Commissioners was for the removal of 13 crossings.

MEXICAN CENTRAL.—Announcement has been made by this company that contracts are about to be let for building the short line to connect Mexico City with Tampico. This will be accomplished by extending the Apulco division north from Apulco. Surveys have been under way for the past three years, and the plans are now in the hands of the Government for approval. The line is to have a maximum grade of less than 2½ per cent. The work will include many bridges and tunnels. Plans have already been completed for the bridge to be built over the Panuco river, which will cost $1,000,000 or more. The company will use a ferry to cross the river pending the building of the bridge. (Aug. 10, p. 39.)

NEW ORLEANS & NORTHERN MIDLAND.—Incorporated in Louisiana with $7,000,000 capital to build north to the Ohio river. H. O. True, of Memphis, is President.

NEW ORLEANS, NATCHEZ & PACIFIC.—This company has been organized at Natchez, Miss., with $6,000,000 capital, to build from Natchez south to New Orleans, 160 miles, and to eventually be extended north to Kansas City. The officers are: A. B. Wheeler, New Orleans, President; W. J. Poitevant, New Orleans, First Vice-President; R. F. Larned, Natchez, Treasurer, and C. E. Moritz, Natchez, Secretary.

NORTHERN PACIFIC.—This company, it is reported, has let a contract to Deeks & Deeks, of St. Paul, to straighten its line from Livingston, Mont., west to the Bozeman Tunnel, eleven miles. The line is to be carried over a new route, shortening the distance by about 1,000 ft., reducing the grade and eliminating curves.

PAUL SMITH'S (ELECTRIC).—This line, recently completed, was put in operation August 21. It is about nine miles long through the Adirondacks from Lake Clear station, in the town of Harrietstown, Franklin County, to Paul Smiths, at Saranac. The company is to build a branch from the main line to Upper St. Regis Landing. The company was incorporated by Paul Smith and others some time ago and has a capital of $100,000. Its title is the Paul Smiths Electric Light & Power & Railroad Company.

PENNSYLVANIA.—An officer of the Philadelphia, Baltimore & Washington writes that the contract recently let in connection with the Washington improvements to the Drake & Stratton Co., of Philadelphia, includes the Maryland avenue subway from Ninth to Water streets and the delivery yards at Sixth, Ninth and Water streets. Excavation work has been started, but no track has yet been laid. There will be considerable shifting of tracks and the building of temporary tracks and roadways for street traffic. A roadbed for the southern trains will also have to be provided. There will be one undergrade and three overhead bridges. (Aug. 31, p. 58.)

PHILADELPHIA, BALTIMORE & WASHINGTON.—See Pennsylvania.

RALEIGH & PAMLICO SOUND.—A contract is reported let by this company to Johnson & Grammet Bros., of Alton, Ill., for building 67 miles of its proposed road from Raleigh, N. C., east to Pamlico Sound. The contract which amounts to about $1,000,000 must be completed by June 15, 1907.

ST. LOUIS, ENID & SAN DIEGO.—Application will be made for a charter by a company under this name, which is being promoted by residents of Guthrie, to build a line through that place in a northeast and southwest direction.

SONORA.—See Southern Pacific.

SOUTHERN PACIFIC.—The new Pacific coast line which E. H. Harriman and associates are building in Mexico is an extension of the Sonora division of the Southern Pacific which has been in operation between Benson, Ariz., and Guaymas, Mexico, for many years. It is authoritatively announced that the 1,500 miles of new

road will be completed and in operation within 18 months. A length of more than 300 miles is already practically completed. The first division of 100 miles is in regular operation, and as soon as the bridge which is now being built across the Yaqui river is finished the second section will be opened. The surveys for the entire line down the coast and to Guadalajara have been completed and the maps and profiles of the proposed route have been submitted to the Secretary of the Interior of the Mexican Government for approval. It is said that the engineers have aimed to get the best line possible regardless of cost of construction. The maximum grade after the line leaves the coast and in crossing the mountains to reach Guadalajara is to be a little more than 2½ per cent. As soon as the official approval has been received a large force of men will be put at work grading from Guadalajara and more than 5,000 laborers will be employed by the first of January. Other grading outfits will be put at work on a central division of the line.

This company is also building a branch north from a point near Torin to a connection with the Cananea, Yaqui River & Pacific, which is also a Harriman property.

Tennessee.—This company, which operates a line from Oneida, Tenn., on the C., N., O. & T. P., through the coal fields and timber land southeast of that place to Walton, 28 miles, is said to have let a contract to Wilson Rodes & Co., of Knoxville, for extending the line 20 miles.

Duluth, Mesaba & Northern.—This company has opened its line to the Western Mesaba range. It extends from the main line at Alborn, Minn., to Bovey, 55 miles. No ore will be moved over the line this year, but it is expected that 1,500,000 tons will be brought out next year.

Western Pacific.—Construction work is progressing well in California, though there is still a great shortage of labor. The contractors are using every possible inducement, except high wages, to secure men, and the company is advertising in the east for 5,000 men, promising to secure very low transportation rates for them. The chief difficulty in keeping men at work on the grading contracts is the high wages to be had in other occupations. In San Francisco men are getting $2.50 a day for cleaning bricks, and skilled workmen receive from $3 to $12 a day at various trades. Tunnel work is going ahead very satisfactorily on the entire length of the line in California. The Spring Garden tunnel, which is to be the longest in the state, 7,300 ft., is in 1,062 ft. on the west end and 460 ft. on the east end. The Niles tunnel, a few miles east of Oakland, is making favorable progress underground, and massive concrete portals have been completed. Although forms for bids for most of the grading of this line through the state of Nevada were sent east some months ago no contracts have yet been let for the work. The projected route through Nevada presents but few serious engineering difficulties except where it passes through the Pequop range and the Gosiute gorge. A tunnel about 12,000 ft. long, piercing this range, has been planned, but the line may be relocated in that section so as to permit of a much shorter tunnel. This would avoid time and delay. The company hopes to have the line opened for business from San Francisco to Salt Lake City in two years. The track in Utah has now reached a point 42 miles west from Salt Lake City, and could be extended at the rate of a mile a day across the desert but for the prevailing floods. The whole country is afloat from the unusual rains in the dry season following an exceptionally severe and long winter. The first track laying of any consequence in California will be done at Oroville. It is the intention to lay 13 miles of track easterly from Oroville to the middle fork of the Feather river so that steel can be delivered for the bridge during the winter. Track will also be laid between Oroville and Marysville on the west. On this section grading has been completed for 13 miles and five miles additional almost completed. The first shipment of ten Western Pacific flat cars has been delivered at Reno, Nevada, for use on the Boca & Loyalton road, which has been acquired by the Western Pacific as a feeder.

RAILROAD CORPORATION NEWS.

Baltimore & Ohio.—Part of the proceeds of the sale of the $27,750,000 new common stock of this company recently listed on the New York Stock Exchange are to be used for the completion of terminals at Baltimore, Philadelphia, Wheeling and Washington; also to reimburse the company for payments made and to be made for second and third track and for the improvement of yards at Chicago Junction, Brunswick and Cleveland.

Buffalo, Bradford & Kane.—According to a press despatch from Pittsburg, the main line of this narrow gage road from Bradford, Pa., to Mount Jewett, 37 miles, will be abandoned and the tracks torn up.

Chicago & Eastern Illinois.—See Evansville & Terre Haute.

Chicago & North-Western.—Gross earnings for the year ended June 30, 1906, the average mileage operated during the year being 7,429, an increase of 21 miles, were $63,481,578, an increase of $7,736,303; net earnings $21,265,302, an increase of $4,169,339. The surplus after paying dividends and appropriating $6,000,000 for improvements and permanent additions ($1,400,000 more than last year) was $2,316,639, an increase of $1,673,741. The annual report shows that during the year the company has acquired 41,000 shares of Union Pacific preferred stock at about $94 per share.

Chicago & Alton.—This company has made a mortgage to the Farmers Loan & Trust Co. of Illinois securing $22,000,000 first lien 50-year 3½ per cent. bonds.

Chicago, St. Paul, Minneapolis & Omaha.—The gross earnings of this company for the year ended June 30, 1906, were $12,943,750, an increase of $1,017,750. The net earnings were $4,632,806, an increase of $383,334. The surplus after charges, dividends and appropriation for improvements is $331,279, an increase of $177,011.

Consolidated (N. Y., N. H. & H. Electric Lines).—See New England Investment & Security Co.

Georgia & Florida Railway Systems.—The Augusta & Florida, Millen & Southwestern, Douglas, Augusta & Gulf and Valdosta Southern Railways are being operated together, under above name. The general office is at Augusta, Ga.

Evansville & Terre Haute.—A dividend of 4 per cent. has been declared on the $3,987,383 outstanding common stock, payable November 1, to shareholders of record September 15th. The last dividend on this stock was for the year of 1901, when 1½ per cent. was paid. The Chicago & Eastern Illinois owns a majority of the stock.

Houston Belt & Terminal Co.—A meeting of the stockholders has been called for September 20 to vote on a proposed issue of $5,000,000 improvement mortgage bonds, the proceeds to be used to pay for new terminals at Houston now under construction. The work includes a union passenger station, freight stations and a belt line entirely around the city laid with 85-lb. rails.

Maine Central.—The gross earnings for the year ended June 30, 1906, were $7,794,745, an increase of $543,209; net earnings were $1,761,659, a decrease of $398,407. The surplus after dividends was $56,218.

New York Central & Hudson River.—The income account for the year ended June 30, 1906, is as follows:

	1906.	Increase.
Gross earnings	$86,622,670	$7,942,851
Net earnings	23,042,505	1,421,426
Charges	22,295,712	216,758
Surplus	9,989,200	1,885,509
Dividends	7,036,195	423,695
Year's surplus	2,953,005	1,461,812

New England Investment & Security Co.—This company, which is to take over all of the electric lines controlled by the New Haven road in Massachusetts, has turned over to the Consolidated Railway Company, in payment for the properties, promissory notes and $1,000,000 common stock and $1,000,000 preferred, being its entire outstanding capital. The Consolidated has guaranteed 4 per cent. dividends on the preferred stock of the new company and $105 per share in case of liquidation.

Nome-Arctic Railway.—The Western Development Company has been organized with $6,250,000 capital to build and operate a railroad and canals in Alaska, and also extensive mining properties. It intends to buy the Nome-Arctic Railway, which has 16 miles of line extending out from Nome.

Southern.—This company has bought the entire capital stock, $2,000,000, of the Virginia & Southwestern for a price said to be $200 per share. The Virginia & Southwestern runs from Mountain City, Tenn., to Big Stone Gap, Va., 134 miles, and has $2,000,000 first mortgage bonds outstanding. It has hitherto been controlled by the Virginia Iron, Coal & Coke Co. Four years ago this stock was given away as a bonus to subscribers to the bonds.

Union Pacific.—See Chicago & North-Western.

Virginia & Southwestern.—See Southern.

Wabash.—A circular has been issued giving the details of the agreement entered into between the company and the debenture bondholders' committee for the retirement of the outstanding debenture bonds. The plan, which is to be submitted at a special meeting on October 22d, is as follows: Each $1,000 debenture A bond is to be exchanged for $775 in the new 4 per cent. mortgage bonds, $560 in preferred stock and $560 in common stock. Each $1,000 debenture B bond is to be exchanged for $700 new bonds, $500 preferred stock and $500 common stock. (Aug. 24, p. 52.)